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PUBLIC WORKS MINISTRY.

REPORT

FROM THE

ADMINISTRATION OF THE PUBLIC WORKS DEPARTMENT

FOR 1899

BY

SIR W. E. GARSTIN, K.C.M.G.,

UNDER SECRETARY OF STATE FOR PUBLIC WORKS DEPARTMENT

WITH REPORTS BY THE OFFICERS IN CHARGE OF THE SEVERAL BRANCHES
OF THE ADMINISTRATION.



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PUBLIC WORKS DEPARTMENT.

ADMINISTRATION REPORT FOR 1899.

The following reports are appended to this Note: --

I.—*Irrigation Branch.*

- (a) Report by Mr. A. L. Webb, Inspector General of Irrigation, Upper Egypt.
- (b) Report by Major R. H. Brown, C.M.G., Inspector General of Irrigation, Lower Egypt.
- (c) Report by Mr. W. J. Wilson, Director General of the Nile Reservoir Works.

II.—*Works other than Irrigation.*

- (d) Report by Mr. A. H. Perry, Director General of Towns and Buildings.
- (e) Report by Captain H. G. Lyons, R.E., Director General of the Survey Department.
- (f) Report by Mohamed Bey Anis, Chief of the Technical Department.
- (g) Report by Monsieur G. de Maspero, Director General of the Antiquities Department.
- (h) Report by Mr. A. J. Cotterill, Engineer in Chief of the Railway Administration and Inspector for the Agricultural Railways.

All of the above will repay perusal to anyone seeking information regarding the work done by the different services, combined under the general classification of the Public Works Department. Each of the writers is an expert in his own particular line, and each report contains many interesting details of the progress made in the particular branch of the Administration to which it refers.

My task in the following note is limited to a description of the work of the Department, as a whole.

This year's Administration Report, contains, for the first time, a report of the work done by the "Service des Antiquités." Although Monsieur Maspero only resumed charge of this Department in November 1899, he has been good enough to prepare a note of the year's work, which note I have attached to this report as an appendix.

The following tables show the expenditure under the Public Works Budget in 1899:—

TABLE I.

ORDINARY BUDGET.

	£E.	Mill.
Central Office	50,611	763
Irrigation Branch.	644,176	537
Towns and Buildings	198,474	230
Survey Department	19,406	235
Technical Service	13,474	953
Antiquities Department	10,144	958
Total.	£E.936,287	776

TABLE II.

EXTRAORDINARY BUDGET, I.E., WORKS EXECUTED UNDER SPECIAL CREDITS.

	£E.	Mill.
New Weirs (money granted by the Caisse)	159,816	582
Special Drainage Works (money granted by the Caisse).	143,483	541
Special Irrigation Works (money granted by the Caisse).	59,144	369
Public Buildings (money granted by the Caisse).	147,593	600
Public Buildings (money found by other Departments).	57,868	634
Total.	£E.567,816	129

TABLE III.

TOTAL EXPENDITURE IN 1899 UNDER BOTH BUDGETS.

	£E.	Mill.
Ordinary Budget	936,287	776
Extraordinary Budget	567,816	129
Total.	£E.1,504,103	905

The above does not include the expenditure upon the Nile Reservoir works, for which "Mandats" or certificates of indebtedness have been issued to Messrs. John Aird & Co.

The value of work executed under this head in 1899 was £883,535 or £E.861,446,625 mill. If this sum be added to the figures given in Table III, the total expenditure controlled by the Department of Public Works in 1899 attains the total of £E.2,365,550,530 mill.

I will now discuss the work done by the different services during the year just past: separating it, as usual, into two classes, viz., "Irrigation Works" and "Works other than Irrigation."

Part I.—THE IRRIGATION SERVICES.

THE NILE SUPPLY IN 1899.

A comparison between the years 1898 and 1899 will show that the conditions, ruling in the former year, were reversed, to a certain extent, in the latter. In 1898, the Aswan gauge registered, on the 1st January, a height of 0·33 metre *below* the average of former years. On the 1st January 1899, this gauge recorded a height of 0·60 metre *above* the average of preceding years.

In 1898, the winter and summer supply was a poor one, followed by a good and exceptionally high flood.

In 1899, the discharge of the river, throughout the first half of the year, was an extremely good one. The flood, on the contrary, was the worst known as far as our records exist.

On the 31st December 1899, the river levels at Aswan were 1·75 metres *below* the average, and 2·17 metres *below* that of the same date in 1898.

From January to June the Aswan levels continued good, and above the mean of previous years. Difficulties of water distribution during this period were consequently reduced to a minimum and no very special measures were necessitated. In July, however, difficulties commenced and continued throughout the period of the flood. Rotations of the canals were not imposed before the 5th June, except in the Gharbich and Menufieh Provinces, but they were not generally removed until the 12th August. The up-stream water levels of the Barrage averaged higher throughout the summer season than those of any previous year. Salt water caused a good deal of trouble in the Damietta Branch. Its entry prevented the pumping stations on the northern reaches of the Nile from taking water from the river. A great deal of extra work was in consequence thrown upon the canals of Eastern Gharbich, and the water supply in this tract proved inadequate to the demand. The early dhurra sowing also caused a tightness of supply for the cotton and rice crops. So much so that, in consequence of the late arrival of the flood, it was found necessary to prohibit them between the 13th July and the 6th August.

The promise held out by the levels of the first half of the year was not maintained, as, before July was past, it had become evident that

the flood was going to be certainly a late one and, in all probability, a poor one into the bargain. The fears upon this point were realised, and, upon the 14th August, the Public Works Ministry officially notified to all those concerned "a Low Nile."

The Aswan gauges in July and August were respectively 0·43 metre and 1·76 metres below the average. As soon as it became evident from the southern gauges that the river could not reach 13 cubits at Aswan by the 15th August, telegrams were sent to all concerned that the flood was going to be a poor one. The "Low Nile" distribution was put into force, and cultivators in Upper Egypt were warned to sow as much "Nabari" as possible upon the higher lands. All proprietors of pumping stations were advised, and the instructions given by the late Colonel Ross, as regards filling the basins, were followed as far as the levels permitted. The lowest level reached at Aswan was 1 pic 20 kirats on the 1st June. The real rise commenced on the 2nd July, and was steady, but very slow, throughout that month. Throughout August fluctuating levels were the rule, and the maximum was reached on the 4th September, when 13 pics 22 kirats were registered at Aswan. This represents a level of 1·23 metres below the average maximum of former years. After this date the river fell very rapidly: this fall even continued until the end of the year, when, as has been before mentioned, the Aswan gauge was 1·75 metres below the average.

The Ministry of Public Works possesses records of the Rodah gauges for the last 100 years, but none exist of Aswan previous to the year 1839. Since this last year, the lowest floods recorded were those of 1877 and 1888, and it is a curious coincidence that the flood of 1899 should, for the second time, carry on the sequence of an eleven year period. In comparing the low floods of the three years of which accurate records exist, it is necessary to consider the mean levels of the river during the whole period of basin irrigation, *i.e.*, not only the height maintained during the period for filling the basins, but also that during the period for the "Sarf" or emptying of the basins. In this connection Mr. Webb, Inspector General of Irrigation, Upper Egypt, has prepared tables which show at a glance the comparison of the three floods:—

ASWAN GATGE.

a. Maximum level recorded.

In 1877 =	13	pics	10	kirats.
In 1888 =	14	..	16	..
In 1899 =	13	..	22	..

(b) *Mean levels for irrigation, south of Sohag. Period between 11th August and 4th October inclusive.*

In 1887 = 12 pics 19 kirats.
 In 1888 = 13 „ 15 „
 In 1899 = 12 „ 17 „

(c) *Mean levels for irrigation, north of Sohag. Period between 10th August and 20th October inclusive.*

In 1887 = 12 pics 9 kirats.
 In 1888 = 12 „ 23 „
 In 1899 = 12 „ 1 „

He has divided the Basins into two great systems, those South and those North of Sohag, and he has based his tables upon the periods during which the filling and the emptying of the basins take place in each section. From the above it will be seen that, although the maximum gauge at Aswan was 12 kirats higher than that of 1877, yet the mean levels, South and North of Sohag, were 2 kirats and 8 kirats, respectively, lower in 1899 than in 1877.

Again, as regards the Rodah (Cairo) Gauge, the flood of 1899 was lower both in respect to its maximum height and to its mean levels than that of either 1877 or 1888, as the following comparison, prepared by Major Brown, will show :—

RODAH GAUGE.

(a) *Maximum height recorded.*

1887 = 17 pics 3 kirats = R.L. 17'65 metres.
 1888 = 18 „ 14 „ = „ 18'05 „
 1899 = 16 „ 20 „ = „ 17'57 „

(b) *Mean level from August 10th to October 18th inclusive.*

1887 = 15 pics 22 kirats = R.L. 17'31 metres.
 1888 = 16 „ 22 „ = „ 17'60 „
 1899 = 15 „ 13 „ = „ 17'12 „

On the Rodah Gauge, between 16 and 22 pics, half pics and kirats were used by the Egyptians. In order to avoid confusion, reduced levels, in heights above mean sea level, are given.

Major Brown gives an interesting table of the maximum height obtained at Rodah by the low floods recorded since the year 1825. This proves the flood of 1899 to have been the lowest recorded in the present century.

Mr. Webb writes :—

“ Compared with the previous low floods, the extremely bad features of the 1899 flood were :—

“ (a) The fall which took place after the 15th August, and the very low levels between that date and the 25th August, whereby the sowing of the “Nabari” was much retarded, and the cultivators greatly discouraged by the extra lift necessary on their Shadoofs.

“ (b) The continued and unprecedentedly rapid fall from the 20th September to the end of October, rendering the “Sarf” operations very complicated, and necessitating special measures for the irrigation of the extensive areas of “Nabari” on the Sahels and higher parts of the basins.”

As soon as the flood was declared to be a low one, all leave in Upper Egypt was stopped and all Irrigation officials (except those in Europe) recalled to duty. Special steamers were provided for inspection purposes and a special credit was granted by the Ministry of Finance. Special measures were taken for storing the water in the basin chains, and passing it on from one system to another. As in 1888, an earthen dam was thrown across the Sohagiyeh canal, whereby an area of 10,000 feddans received water, which could not otherwise have received it. Many special banks and “Hoshahs” were constructed for the purpose of irrigating local tracts. The amount of earthwork, then executed, was some 750,000 metres cube, costing £E.9,252.

The Upper Egypt basins were generally opened to the river between the 10th and 15th of August, but, more especially north of Assiut, many of them were not filled with water until the ordinary time for emptying them had arrived. The “Sarf,” or discharging, of the southern basins commenced on the 25th September, and was completed by the end of October, but no water was passed to the river : all being utilized in filling the systems to the north. The Girgeh “Sarf” was completed by the 25th November, and that of Assiut, Minieh and Beni Suef, by the 10th December. It was recognized that, owing to the low state of the river, it was useless to attempt to obtain the wave artificially produced yearly by means of the great Kosheshah basin. This great escape was, then, manipulated without considering the effect of its discharge upon the river levels. The surplus water in the basin was passed on into the Gizeh system, but, in order to avoid too great a head being thrown upon the structure, a temporary earthen dam was constructed, downstream of the work. By this means the head was reduced from 5.05 metres to 3.20 metres.

Accidents occurred to two of the masonry works in Upper Egypt owing to their having been subjected to too great a strain.

The great Suhagiyeih Syphon blew up on the 16th October, the roof of all four barrels being lifted, and the abutments and piers split across.

On the 16th November, the Masarah escape gave way and collapsed.

In Gizeh, the basins of the west bank of the river were filled by the water of the Upper Egypt chains. East Gizeh was hopeless from the first, and nothing could be done to relieve it. In Lower Egypt proper the situation was saved by the Barrage which, for the first time in its history, was regulated upon throughout the flood. Had it not been for the work done by this structure, there is little doubt that large areas of crop would have been lost. As it is, the cotton crop is very nearly the largest on record, and the maize crop was up to the average. The money expended upon the restoration of the Barrage has brought a full return to Egypt in the results obtained in 1899 alone. In the 1st Circle of Irrigation, comprising the Provinces of Sharkieh, Kaliubieh and Dakahlieh, the flood rotations of canals were resorted to as usual, but not with the usual object of reducing an excessive discharge. They were used to produce artificially full-supply levels at alternate periods, and thus reduce the area of the unirrigated land as far as possible to a minimum. In the 2nd Circle, Provinces of Menufieh and Gharbieh, the flood water was some three weeks late in arrival, and the canals never discharged more than two-thirds of their full-supply. In many localities the cultivators had to lift the water on to their lands throughout the flood season, and, owing to the low levels of the river, the flood feeders gave little or no assistance. In the 3rd Circle, Behera Province, the main supply canal never reached its full flood discharge at all.

SHARAKI AREA IN 1899.

The area, unirrigated in 1899 on account of the low levels of the river during flood, has been measured by the officials of the Ministry of Finance. Chitty Bey, Controller of Direct Taxation at that Ministry, has furnished a statement giving the "Sharaki" area in each Province in Upper and Lower Egypt. He divides this into, what he calls, "whole" and "half" Sharaki, *i.e.* lands wholly and partly unirrigated. In the former a certain area was cultivated by means of wells, and, thanks to the action of the Government in remitting all taxation to the lands in question, distress was hardly felt at all by the people. The immense amount of contract work in progress in the country enabled them to obtain a good daily wage and tided over the interval between the two crops. Chitty Bey's figures (given below)

are not absolutely complete, as a small area has yet to be measured, but they are sufficiently close to warrant their insertion here.

	"WHOLE" SHARAKI.			"HALF" SHARAKI	TOTAL
	Uncultivated	Cultivated from wells	TOTAL		
	Feddans.	Feddans.	Feddans.	Feddans.	Feddans.
Upper Egypt . .	188,562	40,860	229,422	80,502	309,924
Lower Egypt . .	4,021	Nil	4,021	1,312	5,333
Gizeh Province. .	28,904	2,563	31,467	6,720	38,187
Totals . .	221,487	43,423	264,910	88,534	353,444

In Upper Egypt, the Provinces of Kena and Girgeh suffered the most, and account for some two-thirds of the total Sharaki area. In Lower Egypt, the Menufieh Province contributed more than half of the total, while, in Gizeh Province, the greater portion of the Sharaki area was in the isolated tract lying on the east bank of the river, which, from its situation, cannot be assisted in any way by bringing down water from the south. Again, it must not be forgotten that a very large proportion of the above area consists of islands in the river channel. These are entirely dependent upon the height of the river, and, if the water does not rise sufficiently to cover the land, it must of necessity remain unirrigated. In 1877, the total Sharaki area was over 90,000 feddans. It has been shown that the flood of 1899 was a poorer one than that of 1877. The result, that the unirrigated area in the year just passed was only one-third of that of the bad flood of twenty years ago, is extremely satisfactory.

The success attained by the Irrigation Service, in combating the low flood of 1899, is largely due to the works designed and executed by the late Lieut.-Col. J. O. Ross who, after the failure of the flood of 1888, was entrusted with the study of the problem of how to save Upper Egypt in a year of similarly low supply. The measures taken in 1899 are, in the main, those suggested by him, and it is largely due to his fore-sight and grasp of the situation that, in last year's flood, the total Sharaki area has been so small. At the same time, a very high tribute of praise is due to the Inspector General of Irrigation in Upper Egypt (Mr. A. L. Webb) and his staff, for their work during the late flood. During the long and weary period of low levels and flood, Mr. Webb was unceasingly occupied in endeavouring to make the most of the short supply. It was thanks to his energy and activity that the worst flood on record passed away without any particular concern being felt as to its results, and with scarcely a mistake of management having been

made. Mr. Webb controlled all measures by his own personal supervision, and he deserves the fullest credit for the successful conduct of the flood operations of 1899.

Although, in a year of low Nile, the situation of the southern Provinces, as being the most critical, must necessarily be that which engrosses most attention, that of Lower Egypt and of Gizeh is equally important in its way. To Major Brown, who was acting Under Secretary of State during the whole period of low flood, must be given the credit for having saved the cotton crop of Lower Egypt by means of his skilful measures for working the Barrage and for distributing the water. The landowners and cultivators of Egypt owe a large debt of gratitude to these two officers and their respective staffs. Had it not been for their untiring labours, there is no doubt that the agricultural record for 1899 would have been a disastrous one.

The amount of the special credit for Sharaki works in 1899 was as follows :—

	£E.
Upper Egypt	12,156
Lower Egypt	3,217
Central Office and Technical Service	513
Total.	£E.15,886

CROPS IN 1899.

The Cotton Crop.

In spite of the bad Nile, this crop very nearly approaches a record one and is only surpassed by that of one previous year, viz., 1897.

The following is the comparison between the figures for previous years :—

YEAR	Amount of Crop in kantars	Average price reached per kantar
		PT.
1888	2,699,103	272·5
1889	3,200,000	268·0
1890	4,100,100	227·0
1891	4,500,000	178·0
1892	5,200,000	187·0
1893	5,200,000	178·5
1894	4,550,000	192·5
1895	5,203,650	223·9
1896	5,785,532	191·5
1897	6,513,441	162·9
1898	5,579,602	183·2
1899	6,432,776	258·2

* According to the figures given by the Alexandria General Produce Association up to the 6th July, 1899. They may be slightly increased before the season is over.

The average price obtained in 1899 is the highest since 1889. As the out-turn in 1899 is double that of the year 1889, the gain to Egypt in the former year is a very considerable one: in 1889, the value of the crop was £E.8,576,000, while in 1899 it was £E.16,609,000.

The Sugar-cane Crop.

The out-turn was upon the whole good, though the cane suffered in certain localities from want of flood irrigation. In the Keneh and Girgeh Provinces a rather less area than usual was cultivated with sugar-cane owing to the fall in price which has taken place of late years.

The following are the figures for Upper and Middle Egypt for the last four seasons:—

Factories	SEASON 1896-97			SEASON 1897-98			SEASON 1898-99			SEASON 1899-1900		
	Cane crushed	Out-turn No. 1 Sugar	Percentage	Cane crushed	Out-turn No. 1 Sugar	Percentage	Cane crushed	Out-turn No. 1 Sugar	Percentage	Cane crushed	Out-turn No. 1 Sugar	Percentage
Doua Saouh	15,815,112	1,590,752	10.1	11,478,316	1,230,373	8.5	15,680,911	1,251,525	9.2	14,515,565	1,569,958	9.4
Batta Sultan Pasha	587,162	53,589	9.1	451,799	36,510	8.1	479,822	43,885	9.1	466,927	42,058	9.2
Société Générale des Sucre des de la Haute Egypte	1,799,962	195,551	10.9	5,098,890	591,131	8.0	6,250,329	601,002	9.6	5,978,871	575,109	9.6
Egyptian Sugar and Land Company	-	-	-	-	-	-	516,155	19,138	9.5	591,136	16,605	9.2
Bent Kellah	110,000	14,000	8.7	270,000	18,000	6.7	Nil	Nil	—	591,337	46,408	9.2
TOTALS	20,612,756	2,073,492	10.1	20,298,632	1,689,917	8.3	20,957,111	1,950,750	9.3	21,969,136	2,089,637	9.4

It will be seen that the total amount of cane crushed in the season 1899-1900, is larger than that of any of the three preceding years, but that the percentage of 1st class, or No. 1 sugar, obtained is rather less than that obtained in the season 1896-1897.

The Factory of the "Société Générale des Sucrieries de la Haute-Égypte" is the only one that makes use of what is called the "Diffusion" process in extracting the sugar from the cane. All the others extract the juice by crushing machinery.

"Kedi" or Summer Wheat.

The area of this crop is still increasing yearly. Mr. Webb has been at some trouble to estimate the area sown with Kedi in 1899. His

figure is 87,766 feddans, more than half of which is in the Provinces of Kenh and Girgeh. It is a most profitable crop to the cultivator. Its chief disadvantage lies in the fact that the opening of the basins has not infrequently to be delayed beyond the regular date, owing to the large area of basin land cultivated with Dhurra.

The Flood Maize Crop.

The out-turn was fairly good on the whole, but in Lower Egypt the crop suffered from the lateness of the flood, and in Menufieh Province was not more than 70 per cent of the full out-turn. In Upper Egypt the out-turn was good. Owing to the low river, an unusually large area of "Nabari" was planted on the Sahels and in the Hoshahs. The whole of this was irrigated from the river or from the basins: with the exception of some 100 feddans the whole crop was saved.

Winter Crops.

In Upper Egypt they were excellent, the climatic conditions being exceptionally favourable. In Lower Egypt these crops were good on the whole, except in certain limited areas where they suffered from want of water.

The Rice Crop.

This was both good and exceptionally large.

DUTY OF WATER.

The following are the figures given by the Inspector General of Irrigation, as representing the amount of water used per feddan of land cultivated:

UPPER EGYPT PROVINCES.	Duty of water — Metres cube per feddan
Assiout, Minieh, Beni-Souef and Fayum (together).	25·0
Minieh and Beni-Souef (together)	19·0
Beni-Souef (alone)	21·9
Fayum (alone).	21·3

Owing to the high summer supply in Middle Egypt, the duty done by the water was lower than in former years.

LOWER EGYPT PROVINCES		Duty of water — Metres cube per feddan
Sharkieh, Dakahlieh and Kaliubieh . . .	General.	29'00
	Rice . . .	40'00
Gharbiyeh and Menutieh	General.	23'00
	Rice . . .	40'00
Behera.	General.	26'75
	Rice . . .	40'00

The duty of water in the 1st and 3rd Circles of Irrigation is lower than that of the 2nd Circle. These two Circles have hitherto received rather more than their fair share of the available water supply. The year just passed was, however, the last in which the old distribution will be continued. From 1900, each Circle will only receive a quantity of water proportional to its cultivated area.

River Gauges in the Sudan.

With the reconquest of the Sudan, our knowledge of the state of the upper Nile has been considerably extended. During the flood of 1899, the rise and fall of the river was wired daily from Semar, on the Blue Nile, from Khartoum and from Abu Hamed, Merawi and Kerma. The early knowledge thus obtained was very valuable, as although no comparison with former years was possible, still it enabled the Authorities in Cairo to draw conclusions regarding the flood which, taken in connection with the old established gauges at Wadi Halfa and Aswan, permitted them to estimate very accurately the course which it was likely to take, and considerably earlier than would have been possible without this information. Major Brown gives some interesting tables in his report regarding the time taken by the water to travel from one point of the river to another during flood.

The Victoria Nyanza Gauges.

The readings of the above are now duly recorded, but, owing to the unfortunate break which took place in their registration during the period of the Uganda troubles, nothing very definite can as yet be gathered from them.

Steps will be taken next year to erect permanent gauges both upon the White and Blue Nile.

Irrigation Expenditure in 1899.

The following tables give particulars of the expenditure incurred upon Irrigation works. The total sum expended on the Irrigation Budget for 1899 amounted to £E.1,006,621,032 mill.; not including the sums paid by “Mandat” to Messrs. John Aird & Co. for the Nile Reservoir works.

This expenditure is distributed as follows:—

TABLE I.

ORDINARY BUDGET.

	£E.	Mill.
Central Office charges	60,665	601
Upper Egypt	221,549	082
Lower Egypt	361,961	854
Total.	£E.644,176	537

TABLE II.

EXTRAORDINARY BUDGET.

	£E.	Mill.
Drainage Works	143,483	544
Irrigation Works	59,144	369
New Weirs	159,816	582
Total.	£E.362,444	495

TABLE III.

TOTAL EXPENDITURE.

	£E.	Mill.
Ordinary Budget	644,176	537
Extraordinary Budget	362,444	495
Total.	£E.1,006,621	032

The expenditure under “Ordinary Budget” may be again subdivided as follows:—

TABLE IV.

	£E.	Mill.
Regular Budget	209,605	698
Corvée Relief (Caisse money)	249,996	989
Corvée Relief (Ordinary)	149,940	598*
Agricultural Roads	29,087	511
Special credit for Bridges to replace ferries	5,545	741
Total.	£E.644,176	537

*NOTE.—Out of this sum the following was specially expended:—

	£E.	Mill.
Drainage Works, Lower Egypt.	49,178	359
Irrigation Works, Upper Egypt	15,445	990
Total.	£E.64,623	359

“Regular Budget.” again, in above table, is then subdivided :—

TABLE V.

	£E.	Mill.
Establishment	1,386	656
Contingent Charges	18,554	322
New Works,	26,210	687
Maintenance and Repairs	82,218	066
Khatatbeh and Atfeh Pumps	591	279
Drainage of Lake Marcotis,	8,975	000
Land Charges	1,639	688
Total.	£E.209,605	698

Establishment and Contingent Charges.

The former shows an excess of £E.2,326,759 mill., as compared with the charges for 1898.

New Works.

The expenditure under this head is less than that of 1898 by £E.16,701,377 mill. This is due to the fact that the allotments for new works, placed annually at the disposal of the different Irrigation Circles, were reduced in 1899, and the difference added to the General Reserve. From this last it was redistributed between the different credits for Special Works. This procedure was necessitated by the arrangement made with the Caisse de la Dette, by which, when the latter grants a certain sum for special works the Public Works Department agrees to find money for the same purpose from its own Budget. This reduction is, then, more apparent than real. It does not mean that less money has been expended upon new works, but merely that the expenditure appears in a different chapter of the budget.

Maintenance and Repairs.

More money was spent under this head in 1899, than in 1898, viz., £E.6,090,544 mill.

Khatatbeh and Atfeh Pumps.

This item shows a decrease of £E.1,658,721 mill. over the expenditure incurred in 1898.

Drainage of Lake Marcotis.

The expenditure for 1899 shows an increase of £E.360 over that of the previous year.

Land Charges.

These also show an excess of £E.1,339,902 mill. over the expenditure for 1898.

Corvée Relief.

Again referring to Table IV, the next item for remark is that of Corvée Relief.

The expenditure under this head may be subdivided as follows:—

TABLE VI.

	Upper Egypt.		Lower Egypt.		Total.	
	£E.	Mil.	£E.	Mil.	£E.	Mil.
Money furnished by the Caisse . .	128,000	—	121,996	989	249,996	989
Money found from Regular Budget . .	38,445	—	111,495	598	149,940	598
Total. . .	166,445	—	233,492	587	399,937	587

The last two items in Table IV are Agricultural Roads, and Bridges to replace Ferries. The latter may be taken first.

Bridges to replace Ferries.

The expenditure in 1899, was £E.5,545,741 mill. For this sum six bridges were put in hand and at the end of the year were in an advanced stage of completion. They are all in Lower Egypt.

Agricultural Roads.

The following are the figures for 1899:—

LOCALITY	Length of roads existing previous to 1899	Length of roads constructed in 1899	Expenditure on new roads in 1899	
	Kilometres.	Kilometres.	£E.	Mil.
Upper Egypt . . .	518	—	4,144	999
Lower Egypt . . .	1,314	174	24,943	511
Totals. . .	1,832	174	29,087	511

Although no new roads were actually completed in Upper Egypt during 1899, some 69 kilometres were in progress, and upon these the expenditure shown was incurred.

The maintenance charges were as follow :—

	£E.
In Upper Egypt.	2,572
In Lower Egypt.	2,278
	<hr/>
	£E.4,850

The total length of existing roads is now 2,030 kilometres.

The rate of maintenance for Upper Egypt works out to £E.4.96 mill. per kilometre, while that for Lower Egypt is only £E.1.43 mill. per kilometre. As the Agricultural Roads in Lower Egypt are not, as a rule, very well maintained, it is fair to assume that the annual expenditure upon their up-keep is too low. Accepting £E.5 per kilometre as a fair all-round annual charge for the maintenance of these roads, a sum of £E.7,590 would be required yearly for Lower Egypt alone. It is difficult to see where this money is to come from. The steady increase in the length of canals and drains necessitates a steady annual increase in the maintenance charges of the Irrigation Service, and, as it is imperative that such channels shall be kept in working order, it is almost impossible to find money for the roads. It must not be forgotten, moreover, that the length of new roads is yearly being added to, so that the maintenance difficulty is one of yearly increasing intensity. The only possible way out of the difficulty, as regards the regular Budget, would be to reduce the money spent upon new works. As these last are all for the improvement of irrigation and drainage, it could be hardly advisable to do this. Major Brown proposes a special road-tax to be annually levied upon the cultivated area. The idea is worth thinking over. No new roads are nowadays made except at the request of the people interested. The latter pay for their construction, and they might perhaps be required to pay for their maintenance as well, more especially as the annual sum per feddan would be a very small one. Major Brown estimates it for Lower Egypt at 7 milliemes per feddan per annum. The matter is one that might advantageously be discussed at the Provincial Councils, when they assemble for the purpose of voting money for the construction of new roads.

Major Brown again presses for the formation of a special Road Department, and that the Irrigation Officers should be relieved of this portion of their existing duties. While fully admitting that the fri-

gation Officers, each and all of them, have as much work to do as they can well get through. I do not see my way, as yet, to recommending such a measure to the Government, more especially as Major Brown's estimate for establishment alone, amounts to between £E.8,000 and £E.9,000 per annum. This reform must, I think, wait until our present heavy annual expenditure upon special Irrigation works can be reduced. The question of annual maintenance is different, and some means must be found for obtaining funds wherewith to keep these roads in good repair; otherwise the construction of new ones will have to come to an abrupt ending.

The only items of the Irrigation Budget remaining for discussion are those coming under the head of New Works, Maintenance and Repairs. Also those works executed under the special credits, under the head of extraordinary expenditure. As it is difficult to entirely separate the different works under the two heads, I will not attempt to do so, but will briefly describe them in the order used in previous annual Reports.

Masonry Works, New and Repaired.

The following is the detail of the expenditure, which does not include any of the works constructed or remodelled under the Special Credits granted:—

	New Works,	Alterations and Repairs to existing works	Totals
	£E	£E	£E
Upper Egypt . . .	11,801	8,655	20,456
Lower Egypt . . .	4,001	4,947	8,948
Totals. . .	15,802	13,602	29,404

In the above expenditure, 68 new works were constructed for the improvement of the Irrigation System, and between 40 and 50 existing works were remodelled and repaired. As these works were mostly of comparatively small size, no special mention need be made of any one of them. The Barrage maintenance is not included in the above expenditure. It will be treated separately.

THE BARRAGE.

The ordinary maintenance charges, in 1899, amounted to £E.15,647. against £E.20,099 expended in 1898. This economy is due to the fact that no special works were required last year in connection with the repairs to the structure. The river training expenditure was also less than usual, the low flood having entailed little change in the channel. The above sum includes, in addition to river protection, the cost of keeping up the gardens, and the salaries of the whole staff, permanent and temporary. It has already been stated that regulation was maintained at the Barrage throughout the entire period of the flood, the gates never having been fully opened. Notwithstanding this, no action was apparent downstream of the work after the flood had passed, and no signs of weakness showed themselves in the masonry or floor.

The New Weirs downstream of the Barrage.

Excellent progress was made with these works last year. The Damietta Weir was carried right across the river, and the lock completed up to a certain height. The Weir-crest was purposely left lower than the level to which it will eventually be completed, *i.e.* R.L. 12.50 above mean sea level. It was completed up to a height of R.L. 11.50, with the exception of two openings of 100 metres each, which were left at R.L. 11.00. This was done with the object of studying the effect of the weir upon the river, during flood, before finally raising it to its full height. In 1899, the flood passed over it with practically no afflux, and with no action whatever upon the stone talus and protective works.

The lock walls were brought up to the height of R.L. 13.20 all over. The total cube in the core-wall was 20,256 metres, and 69,461 barrels of Portland cement were used in its construction. The price of cement having risen from 50 P.E. to 60 P.E. the barrel, the cost of this work was slightly higher than was anticipated. In spite of this fact, the rate worked out to 2.40 P.E. per metre cube of sub-aqueous wall, including everything. In addition to the work done upon the Damietta Weir, materials were collected for the Weir in the Rosetta Branch, and plant was purchased. Dredging commenced in this branch upon the 1st November 1899, and was sufficiently advanced to permit of two of the core-wall blocks being completed by the end of the year.

The total expenditure, up to date, upon these two Weirs has been.	£E.
The expenditure for 1899 was as follows	241,729
	159,873

That such excellent progress has been made upon these works is almost entirely due to Major Brown's own personal exertion. His staff worked most loyally and deserve the fullest meed of praise. He, however, directed and controlled every detail, living upon the work throughout the greater portion of the season, and it is thanks to his skilful arrangement and to his energy, that the Damietta Weir was completed, including all necessary protective works, before the arrival of the flood. In addition to this work, Major Brown continued to carry on his current duties as Inspector General of Irrigation, and directed all the work of his Service as usual. He has good reason to be proud of his year's work.

EARTHWORK EXECUTED IN 1899.

The following are the dredging totals:—

LOCALITY.	Metres cube dredged.	Cost
		£E
Upper Egypt	129,367	4,872
Lower Egypt	2,393,578	82,507
Totals.	2,522,945	87,379

The dredging cubes on the Ibrahimieh Canal were the lowest on record. The total was 129,367 metres cube, costing £E.4,872.

These figures compare favourably with those of previous years. In 1884, for instance, a cube of 1,114,698 metres cube was executed on this canal at a cost of £E.34,656. The economy is almost entirely due to spurs constructed in the channel.

The cube of earthwork executed by hand labour was as follows:—

LOCALITY	Metres cube.	Cost.
		£E.
Upper Egypt	10,151,570	128,139
Lower Egypt	12,628,581	205,545
Totals.	22,780,351	333,684

In the above, the earthwork executed upon the new drains is included, representing a total of 5,306,859 metres cube.

The rates per metre cube of earthwork done by hand works out as follows:—

Upper Egypt	1.26	Piastres Egyptian.
Lower Egypt	1.67	.. ..

The rate for the whole is equal to 1.41 Piastres Egyptian per metre cube.

The Lower Egypt rates are necessarily higher than those of Upper Egypt on account of such a large proportion of the work being “Wet,” *i.e.* executed in canals and drains with muddy bottoms.

DRAINAGE WORKS IN 1899.

The expenditure upon drainage works in 1899, although not so large as that of the year previous, was still considerable, and good progress was made towards the completion of the drainage system of Lower Egypt. The Commissioners of the Public Debt granted a credit of £E.150,000 for these works, and the Public Works Department devoted a sum of nearly £E.50,000 to the same end. The amount of money available for drainage improvements on 1st January 1899 was therefore as follows:—

	£E.	Mill.
Credit granted by the Caisse de la Dette.	150,000	000
Money found from Public Works Budget	49,178	359
Balance unspent from credit for 1898.	8,493	358
Total.	£E.207,671	717

The expenditure for the year was £E.192,666,893 mill., leaving a balance unspent of £E.15,009,824 mill.; of this balance, the greater portion was due for land taken up for the new drains. The accounts for this land not having been presented in time by the Mudirieh Officials charged with their preparation, the cheques in payment for the land could not be issued in 1899, and the sum has necessarily to appear as a balance to be carried over to the year following.

For the money expended, 136 kilometres of existing drains were remodelled.

The earthwork cubes amounted to 5,306,859 cubic metres, of which 823,389 cubic metres were dredged, the balance being executed by hand-work.

The expenditure incurred also includes the construction of 334 masonry and iron structures in connection with these drains, such as siphons, aqueducts, iron and masonry bridges, irrigation regulators, etc. 148 timber bridges were also erected.

The principal drainage systems remodelled in 1899, were as follows :—

In the Sharkieh and Dakakieh Provinces.

The Bahr El Bagar, the Bahr El Tawil and the Ma-raf El Arin.

In the Gharbich Province.

The Muhit, the Demilash, the Bahr Mallah, Fouah and Nashart.

In the Beherah Province.

The Edku and Khairi drains, and the Khandak El Gharbi drain.

In addition to the main systems, mentioned above, a large number of smaller systems and branch drains were taken in hand.

The work of erecting the three new centrifugal pumps at Mex, to which allusion was made in my last year's report, was completed in 1899. A sum of £E.16,536 was expended in 1899, chargeable to the special credit. This includes, besides the pumping station itself, homes for the Staff, electric plant and a breakwater. The pumping power at Mex has been doubled by the erection of these pumps, and the maximum lifting power of the seven pumps installed at this station is now three millions of metres cube of water in twenty-four hours.

The amount of water lifted by the new pumps in the winter 1898-1899 was 284,896,064 metres cube. The cost of this was £E.8,378. This amount is the largest yet lifted by these pumps in a single season. Their task was an unprecedentedly heavy one, owing to the very heavy winter rainfall. The water in the lake rose to the very high level of 1.95 in December 1898, and, in spite of continuous pumping, remained a little below that level for some three months. Notwithstanding the large quantity of water lifted, the total sum expended was less than that of the previous season. The year just past is the first in which the working of these pumps has been wholly run by the Government. Previous to this year, a portion of the cube was done by contract. The change has resulted in a considerable economy, as the following figures will show :—

SEASON	Cost of lifting water per million cubic metres	
	£E	Mall
1895-96	43	400
1896-97	37	—
1897-98	38	—
1898-99	30	—

The pumps at Kassassin, in the Province of Sharkieh, worked as usual. These pumps were erected for the purpose of draining the area

known as the Wadi Tumilat, to which allusion will be made later. The expenditure in pumping was £E.1,224, of which £E.799 was found by the Government, and the balance by the Wakf's estate.

Major Brown in his report gives some interesting notes regarding the drainage of Lake Edku in the Behera Province. He is of opinion that any attempt at regulating the outlet to the sea from this lake would have doubtful results, and he fears that it might do more harm than good.

In Middle Egypt very little was done in the way of new drains: £E.434 having been spent in the Fayum upon the construction of some minor channels. Plans and projects for remodelling the drainage system in this Province upon an extended scale are now in course of preparation.

Maintenance charges for drains were as follows :

	£E.
Upper Egypt	4,858
Lower Egypt	13,918
Total.	<u>£E.18,776</u>

In last year's Report I drew attention to the fact that the question of drain maintenance was one of serious and increasing importance. It is practically certain that, in a few years time, the regular budget will be unable to meet the cost of clearing all the new drains annually, in addition to the irrigation canals. Every possible economy is insisted upon, but if the country is to reap the full benefit from the new channels, money must annually be spent upon their clearance, and this in yearly increasing sums.

Taking all these different items into account the total expenditure on works connected with drainage in 1899 was as follows :—

	£E.	Mill.
New Drains, Lower Egypt	192,661	893
New Drains, Upper Egypt	434	000
New Pumps	8,378	000
Kassassin Pumps	799	000
Maintenance	18,776	000
Total.	<u>£E.221,048</u>	<u>893</u>

Main Irrigation Improvements in 1899.

The greater portion of the expenditure upon such works was in Upper Egypt. In Lower Egypt much of the funds allotted were devoted to drainage.

The money available was as follows:—

	£E.
Credit granted by the Caisse de la Dette	60,000
Money found from Regular Budget.	30,000
Total.	<u>£E.90,000</u>

The expenditure of the year amounted to £E.89,905, subdivided as follows:—

	£E.
Yusfi Canal remodelling	72,813
Bahabshin Basin	13,000
Remodelling Projects.	3,217
Sundries	875
Total.	<u>£E.89,905</u>

The first project consists of the improvement of the system of basins lying to the west of the Yusfi Canal, and between it and the Desert. The object of the new works is to improve the flood supply of this area and insure its receiving a proper proportion of the water at the time when the fertilizing elements are present in suspension. The scheme consists of two large regulators and locks in the Bahr Yusfi, and the construction of basins for the irrigation of 70,000 feddans of land. The entire project is estimated to cost £E.200,000. Good progress was made with these works in 1899.

The second project consists of the construction of a new basin, separating the high southerly portion of Koshesha Basin from the lower, or more northerly area. This will greatly improve the irrigation of some 26,000 feddans of land. The works, including the construction of three regulators, were completed before the flood of 1899; most fortunately so, as owing to the low flood, without this new basin, some 12,000 feddans of land would have been "Sharaki."

The third item consists of the expenditure entailed by the preparation of the projects for converting the basin area, east of the Bahr Yusfi, in the Assiut, Minich and Beni Suef Provinces, to perennial irrigation. An immense amount of work has to be done in order that these works shall be ready simultaneously with the completion of the Nile reservoir at Assuan. A new Irrigation Circle has been formed under the direction of Ismail Bey Sirri for the preparation and execution of these projects. Very considerable progress was made in the year 1899.

Works connected with Navigation.

In Lower Egypt, the chief work in connection with navigation was the construction of the Saneta Lock on the Mansourieh Canal in the

Province of Dakahlieh. This work was completed on the 9th February 1899, and through-navigation was secured on the continuous line of canals which starts from the Barrage, and runs down to the town of Menzaleh, close to the lake of that name. The result of this improvement was at once visible in the increased sum derived from the tolls at either end of this canal system, viz., at the Rayyah Tewfiki Head, and at the Mansourah Lock.

The figures for 1898 show a total of £E.1,704, collected at these two places, whereas in 1899 the amount was £E.4,287.

In 1899 the whole of the river tolls taken at the Barrage, show an increase.

The following are the figures for the last ten years :—

YEAR	Amount of tolls collected	
	£E.	Mill.
1890.	7,761	337
1891.	7,977	773
1892.	8,129	725
1893.	8,349	180
1894.	7,236	278
1895.	8,550	765
1896.	7,311	089
1897.	6,294	330
1898.	8,800	376
1899.	14,980	919
Total.	85,391	772

The increase in 1899 is very remarkable. It is partly due to the Saneta Lock, but the tolls upon the Rayyah Menufieh and those upon the Rosetta Barrage lock both shew a very large increase in 1899. This is accounted for by the fact that the Damietta Branch of the Nile was practically closed to navigation owing to the works in connection with the new weirs. Boats, in consequence, were obliged to make use of the navigable canals running on either side of this Branch. As regards the increase in the tolls on the Rosetta Branch of the Nile, this, curious as it may sound, is due to exactly the opposite cause, viz., that in consequence of the closure of the Damietta Branch, a larger supply than usual was turned down the Rosetta Branch, and navigation in the river was thereby improved. The Behera Canal is not navigable throughout its length and boats were therefore obliged to take to the Nile. It is to be hoped that ere long all tolls upon bridges and locks may be abolished and that the waterways throughout Egypt may

be free to all. The perception of the tolls causes very considerable annoyance to the people, and, as many of the locks are in remote situations where supervision is difficult, many abuses result.

RIVER TRAINING WORKS.

The following is the expenditure of 1899 :—

	£E.
In Upper Egypt	2,329
In Lower Egypt	<u>27,542</u>
Total. . .	£E.29,871

The expenditure for Lower Egypt includes that of the training works in connection with the Barrage, and spurs upon the Rayyah Menufieh. The flood was such a low one that no special, or indeed any protective measures, were necessary throughout its duration.

THE NILE CORVÉE IN 1899.

The figures for 1899 are naturally the lowest on record.

The following represent the number of watchmen called out to guard the banks per 100 days :—

Upper Egypt.	6,662
Lower Egypt.	<u>726</u>
Total. . .	7,388 men per 100 days.

In Lower Egypt the Corvée was practically non-existent, the few men called out being required to watch important points, subjected to abnormal heads of water owing to the exceptional circumstances of the season, and to prevent water from escaping back from the canals into the river.

In Upper Egypt the watchmen were employed almost exclusively upon watching the basin banks, and this is an annual task which is practically independent of the height of the river. It would be unfair to compare the numbers of men called out in a low year like 1899 with those of any ordinary year; only the preceding low years must be used for this purpose. Of the figures for 1877 we have no accurate records. Since 1877, the three lowest floods previous to that of 1899 were those of the years 1888, 1893 and 1897.

The following is the comparison for the four years :—

1888	58,788	men for 100 days.
1893	32,752	" "
1897	11,067	" "
1899	7,388	" "

Steady improvement can, then be recorded. The difference between the figures of the two similar floods of 1888 and 1899 is very remarkable.

THE WADI TUMILAT.

The works connected with the reclamation of this tract deserve a special mention.

Major Brown in his Report gives a very interesting "Résumé" of the year's operations, and I will merely glance at the items which seem to me to be of chief interest. The special arrangement made with the Wakfs Administration was described in my Report for 1898. In the year 1899 the new arrangement came into force.

The tract has been made over for eleven years to the Public Works Department, which latter undertakes to reclaim it within that period, handing it back to the Department of Public Instruction, to whom it belongs, and guaranteeing to this last the annual revenue which it has hitherto derived from it. The Wakfs Administration advances a sum of £E.62,189 for the necessary works. The entire revenue resulting from the tract, less the sum guaranteed to the Ministry of Public Instruction, is handed over, with the administration, to the Public Works Department, which last has to bear all maintenance charges. Lastly, the Wakfs Administration will recoup itself for the money advanced from the increased revenue resulting from the reclamation works.

The area of the tract as measured in 1891, was 20,539 feddans, of which 7,560 were cultivated. The remainder were water-logged and uncultivable.

In the estimate presented to the Government in 1898, the forecast was as follows:—

	£E.
At the end of the first year, a deficit of	3,640
" " second year, a deficit of	2,150
" " third year, a surplus of	350

and after that a yearly increasing surplus, amounting at the end of the eleventh year to £E.12,900.

I am happy to say that the results of the first year's work have very largely diminished the estimated deficit. The actual figures show the deficit for 1899 as £E.230, but it should really be £E.1,029, as the sum of £E.799 (cost of pumping) was charged to the Public Works Budget. Even with this addition, the deficit is only one-third of what it was estimated to be. Further, Major Brown estimates that in 1900,

instead of a deficit of £E.2,150, there will be a surplus of £E.101, and that in 1901 the estimated surplus of £E.350 will be increased to £E.886.

The results of the first season's work have certainly been most encouraging. Again, instead of only 1,000 feddans, as was anticipated, having been reclaimed, 1,856 feddans were restored in 1899. It is proposed to take up and reclaim 2,000 feddans in 1900. If this rate can be maintained, the period of eleven years should be considerably reduced.

These very satisfactory results are largely due to Mr. Langley, Inspector of the First Circle of Irrigation, and to Mussa Bey Ghalib, his assistant, to both of whom great credit is due.

The principal works executed in 1899 were:—

The main drain was enlarged and remodelled. Branch drains for an area of 1,500 feddans were dug, and the canal system was improved. The foundations for the erection of a new 20-inch and a new 30-inch pump were completed in 1899. The total expenditure on the above was £E.7,132.

The arrears of the tract from 1888 to 1896 amount to a sum of £E.26,574. These appear to be irrecoverable.

BORING FOR WATER SUPPLY.

These were undertaken at Medinet El Fayum and at Beni-Suef with the view of ascertaining whether the water supply of these towns could be secured from a subterranean source as has been the case at Tanta in the Delta. In neither case were the experiments successful.

In the Fayum, the borings were carried down to a depth of 205·7 metres below the surface, or to 182·3 metres below mean sea-level. At this depth no water was found. The cost of this boring was £E.405. At Beni-Suef the pipes were taken down to 96·82 metres below mean sea-level, or to a depth of 125 metres below the ground surface. The cost of this work was £E.235, but in this case also no water was found. The rate per lineal metre of boring was as follows:—

	£E.	Mill.	
Fayum.	1	970	per metre run.
Beni-Suef.	1	880	„ „

Experiments are to be made in the Behera Province, where it is to be hoped that the results will be more satisfactory.

THE NILE RESERVOIRS.

An excellent start was made with these works in 1899. Mr. Wilson, Director General of the Reservoir works, gives a full report of the progress upon each, and of the difficulties that had to be overcome. I will briefly touch upon the most important points embodied in his note.

THE ASSUAN DAM.

The work of the year 1898 had been limited chiefly to preparation for the following season, to the collection of plant and materials, and to the housing of the staff. A certain amount of excavation was executed, but it was not until the spring of 1899 that the masonry was commenced. The foundation stone of the dam was laid by H.R.H. the Duke of Connaught on the 12th of February, and masonry was commenced on the 16th March. By the end of the year 1899, 74,703 metres cube of masonry had been completed. The greatest amount executed in any one month was in July when 16,094 metres cube were done. Commencing from the east bank of the river, masonry was carried on throughout a length of 620 metres. Of this 540 metres in length were raised to a height sufficient to permit of work being carried on throughout the flood. The length in question consists of that portion of the dam which is solid, and which is not pierced with openings. For a length of 360 metres the work was brought up to R.L. 107 or to within 2.0 metres of full height. The masonry consists of rubble with roughly squared rubble faces. It is all laid in mortar composed of a mixture of Portland cement and sand. In the face-work the proportion was, one part of cement to two parts of sand, and, for the interior work, one part of cement to four parts of sand. By the end of 1899, the excavation for the foundations had been completed for a total length of 740 metres, and was in progress throughout a length of another 600 metres. In all cases the excavation was carried down to the sound rock. Unfortunately, over considerable lengths of the line of the dam, the rock underlying the surface granite was found to be decomposed and disintegrated. In some parts of the trench it was so soft that it could be removed by picks. It consists of decomposed schists, traversed by seams of clay. This necessitated excavation of the foundations to a much greater depth than had been anticipated or estimated for. In some instances the founda-

tions were carried down to a depth of as much as 8·0 metres below the level allowed for in the drawings. This extra depth has considerably increased the cost of the work, as, not only is the cube of the excavation largely augmented, but the extra depth of trench has afterwards to be filled up with solid granite masonry in cement. This extra work was unavoidable and at the same time impossible to foresee. The amount of excavation on the line of the dam executed by the end of the year was 100,212 metres cube, and the total value of work done upon the dam proper was £237,284. Good progress was also made with the excavation for the navigation channel and locks on the western bank. 300 metres of the channel upstream of the dam were excavated to the full depth and width.

The cubes of work done were as follows:—

Earth excavation	161,177 metres cube
Rock excavation	107,275 ..
Stone pitching.	13,603 ..

The value of the above was £56,677.

One of the most important works, carried out in 1899, was the closing of three out of five of the deep channels which traverse the line of the work, by temporary dams or "Saddles." The channels selected for closure were those known as the Bab El-Kebir, the Bab El-Haroun and the Bab El-Soghair. The fall of the water through these channels, at low Nile, is 3 metres in 200 metres, (taking 100 metres above and below the axis of the dam.) The rush of water through them was very great, and, as each opening was closed, the rush through those remaining was increased; so much so that, in closing the last of the three, the Bab El-Soghair, stones weighing as much as three or four tons were carried away by the force of the water. In order to close these openings, stone dams were made across each of them, before the flood, to a height of 5 metres below ordinary flood-level. Large stones, weighing from 1 to 4 tons, were first thrown in, and then smaller stones to fill up the interstices. Masses of stone enclosed in wire nettings were also used. The Bab El-Kebir was first closed under a head of 2 metres of water, then the Bab El-Haroun, and lastly the Bab El-Soghair. The greatest depth of channel was on the Bab El-Kebir, where as much as 19 metres was reached. Owing to the rush of water before mentioned, the closure of the Bab El-Soghair was a work of considerable difficulty. Mr. Fitzmaurice, the Engineer in charge of the works, succeeded in closing it by an ingenious expedient. He loaded two large railway wagons with masses of stone contained in wire netting. Each mass of stone and wire weighed from 2 to 8 tons,

and the whole was bound together with steel wire. Each wagon with its contents weighed some 25 tons. Rails were then laid to the end of the opening and the two wagons were run bodily into the gap. These formed a mass, against which it was possible to pile in stone, and the opening was closed on the 11th July. The closure of these three channels raised the water upstream by about one metre, and the head upon the Sudds was 3.74 metres. The total quantity of stone used was some 45,000 metres cube.

During July, with the rising flood, the dam closing the Bab El-Haroun gave way but the other two remained sound. Work was recommenced on this channel on the 11th November, and by the 6th December it was again closed.

As soon as the flood had passed, sandbag Sudds were made across each channel on either side of the line of excavation. These were commenced on the 3rd November and completed by the 4th January 1900.

A considerable amount of the iron-work for the under sluices was delivered in 1899.

THE ASSIOUT WEIR.

Equally good progress has been made with this work as at Assuan. It was found necessary to change the design for the foundations as originally approved. The present foundation consists of a continuous floor of concrete and masonry, 3 metres thick, enclosed between iron sheet-piling. In the original design, the work was founded upon brick-wells sunk in the bed of the river. These were abandoned for two reasons. In the first place, the period during which work can be carried on in the river bed is very short. In the second place, it is difficult, in Egypt, to obtain workmen skilled in well-sinking, and further the contractors themselves had had no experience of this class of work. Had the design for well-foundations been adhered to, the work would have taken much longer to complete than is likely to be the case with the present design.

The Assiout Weir consists of one hundred and eleven bays of 5 metres each. The piers are 2 metres thick, with twelve abutment piers each 4 metres thick. The lock on the western shore is 80 metres long by 16 metres wide. The total length of the work from the face of the lock-wall to the eastern wing-wall is 821.2 metres.

Work was commenced upon the western end. On the 2nd January the earth works were commenced, and these were completed by the

15th February. Pumping commenced on the 19th February. The area enclosed by these dams was 43,000 square metres. Fourteen pumps in all were employed on the unwatering, their united force being equivalent to that of eleven 12-inch pumps. The length of the cast-iron piles was 16 feet. To these an upper piece of 10 feet was added, and afterwards removed when the pile was driven to its full depth of 40 metres below the bottom of the concrete. The piles are grooved and tongued, and are made water-tight by grouting the interstices of the joints with cement. Concrete was started on the 4th May, and masonry on the 7th May. The bricks burnt by the contractors turned out badly, and the masonry in the floor was built entirely of rubble laid in cement mortar. Above the floor level, mortar composed of lime and "Homra" was used. The work completed in 1899 consisted of the foundations of the lock and 210 metres in length of the Weir. The masonry of the lock walls and of twenty-three piers was raised to from 2.5 metres to 4.0 metres above the floor.

The earthen dams were cut on the 7th August, and the season's work protected by piles and sand bags. After the flood had passed, work recommenced. Excavation was begun on the 9th December and the masonry of the lock commenced on the 26th December.

The season's work consisted of:—

Earthwork.	361,735 metres cube
Concrete	10,561 ..
Rubble masonry	25,514 ..
Clay puddle	7,238 ..
Stone pitching.	21,211 ..

The following is the expenditure for the year 1899:—

Assouan Dam permanent work.	£ 273,075
Retention under Clause 39 of Specification	29,264
Payment on account of permanent work deducting retention .	243,811
Advances on preliminary works	72,796
.. plant	53,545
.. materials	112,813
.. Messrs. Ransomes & Rapier	55,972
Total.	£568,887
Assiout Weir—advances on permanent work	£ 274,917
.. .. payment for land. . . .	12,100
.. .. Import duties.	18,300
Subsidiary works.	305,917
Grand total.	£883,535

The expenditure in 1898 was £176,357.

The total expenditure up to 31st December 1899 then becomes £1,059,892. In this, of course, there are large advances for materials, etc., to be worked off.

The climate both at Assouan and Assiout during the summer months is most trying, and the heat intense. At both places work had to be carried on by night as well as by day. Mr. Fitzmaurice and Mr. G. Stephens, the resident Engineer at Assouan and Assiout respectively, spared themselves in no way, and no praise of mine can be too high for the work that both these officers have done. In their efforts they were loyally seconded by their respective staffs. Mr. John Blue, Messrs John Aird's representative, upon whose shoulders fell the colossal task of providing the materials, labour, etc., necessary for the successful prosecution of these works, has, I think, good reason to congratulate himself upon the result of his year's labour.

The Director General of Reservoirs is Mr. Wilson, and he is charged with the general direction of both these works. Mr. Wilson's work in Egypt is so well-known, and his reputation stands so high, as to need no further praise from me. Sir Benjamin Baker, K.C.M.G., in his capacity of Consulting Engineer for these works, visited them twice in 1899, once in the spring, and again in the late autumn. In every instance, his advice upon all questions connected with the works has been followed by us.

AGRICULTURAL RAILWAYS.

I again include mention of these lines in the portion of this report which is devoted to Irrigation works. I do this because the construction and alignment of these railways are still to a certain extent controlled by the Irrigation officers. Nothing can be said in favour of this custom, and much can be said against it. The only reason of its existence is the difficulty of finding any substitute for the Irrigation control. The formation of a Light Railway Board, with powers to examine and decide all questions relating to these Light Railways, is at present under consideration. I trust that, before the time comes for next year's report to be written, the formation of this Board may have become an accomplished fact.

Mr. A. J. Cotterill, Engineer in Chief of the Government Railways, at present acts as Inspector of the new lines under construction, and he has presented a report which I have added as an appendix to my own.

336 kilometres of new line were opened to traffic during 1899. The total length of railway existing at the end of the year in question was $694\frac{1}{4}$ kilometres.

A few projected lines, amounting to 42 kilometres, have been abandoned, and projects for the construction of 489 kilometres of new line have been submitted, or are in course of preparation. It will be seen from the above that Egypt will ere long be better furnished as regards a light railway system, than most other countries in the world. Considering the Light Railway as a whole, no proof can be adduced that they have competed unfairly with the States lines, although in one or two local instances the receipts of the latter may have been reduced. Most of the Light Railways being feeders to the main lines, these last must eventually profit by the construction of the former, which bring them traffic instead of taking it away. The passenger traffic has increased very satisfactorily, the number of passengers per kilometre per annum being 3,500 for the Delta lines and 4,500 for the *Chemins de fer Economiques*. 562,000 passengers travelled on the former system up to the end of September 1899, representing a receipt of £E.12,730; and 654,000 on the latter, with a receipt of £E.13,259.

It may be mentioned here that, when the *Chemins de fer Economiques* reduced their minimum charge from 1 P.E. to $\frac{1}{2}$ P.E., the number of passengers, during the first month, increased by 60 %, and the receipts were larger in spite of the general reduction in rates.

The total receipts on newly opened lines, forming only portions of the whole system, cannot be taken as any true indication of their possible future developments. Admitting this, it is satisfactory to record that already the receipts show fair promise. During the year 1899 (ending September) the receipts of the Delta lines were £70 per annum per kilometre, but later in the year (during the cotton season) they increased to £150 per annum per kilometre. The receipts of the *Chemins de fer Economiques* averaged about £100 per annum per kilometre, and for a short time rose to a maximum of £E.170. In both instances the rolling stock was insufficient to carry all the cotton that was brought to the stations. There seems to be no likelihood of the Government being called upon to pay any of the interest guaranteed. Almost everywhere the Companies have availed themselves of the permission given to them, and have reduced their tariffs.

Telegraph lines for a length of 263·5 kilometres have been opened by the different Companies, and telephones for a length of 449·5 kilometres.

Only one fatal accident has so far occurred on any of these lines since they were opened to traffic.

In conclusion, it may be stated that the prospects of these lines promise fairly well. They have to suffer much from water competition,

and to a more limited extent from the donkey, the camel and the conservatism of the Fellah. With time and good management, their receipts will increase, and a more general use be made of them. The fuller development of the system will secure this last.

They have undoubtedly rendered a great service to the agricultural and provincial population.

THE IRRIGATION STAFF IN 1899.

I have already alluded to the great services rendered by Major Brown, Mr. Webb and Mr. Wilson. The work done by these officers speaks for itself. It only remains for me to cordially endorse the praise which they, in their respective reports, give to the Inspectors of Irrigation and their separate staffs. All these officers have done excellent service, and to their efforts is largely due the success attained in the season of 1899.

The Irrigation Inspectors are: Messrs Langley, Verschoyle, Dupuis, Clowes, Mahmoud Sidky and Hassan Wassif. The Department suffered a severe loss in 1899 by the death of Mahmud Bey Sabri. He was an excellent officer and did good and loyal service to Egypt for many years. His death was, in great measure, caused by his devotion to his duty, as, although suffering from a very painful disease, he continued to work throughout the low flood, until he broke down completely. When at last, he was forced to rest, it was too late to save him. I have known Sabri Bey well, ever since my arrival in Egypt, and I regret his loss keenly. The vacancy caused by his death has been filled by Hassan Bey Wassif, one of the most promising of our Egyptian Engineers.

With regard to the junior members of the Irrigation staff, I can only repeat my remarks of last year, that, if I do not mention each of them by name, it is not because I do not fully appreciate the excellent services which they have rendered to the Department.

W. E. GARSTIN.

*Under Secretary of State
for Public Works.*

Cairo, July 10th, 1900.

Part II.—WORKS OTHER THAN IRRIGATION.

II.—THE TOWNS AND BUILDINGS SERVICE.

This Service has done a large amount of useful work during the past year.

A reference to Tables I and II, page 4 of this note, gives the total expenditure under the heads "ordinary and extraordinary."

The following shows this expenditure subdivided in more detail.

The total expenditure for the year was £E.403,845.864 mill. This is distributed under the following heads:—

	£E.	Mill.
(a) Ordinary Budget.	198,474	230
(b) Special Credits provided by the Caisse de la Dette	147,503	000
(c) Special Funds supplied by other Departments	57,868	634
Total.	£E.403,845	864

The details of the above are as follows:—

(a)—ORDINARY BUDGET.

	£E.	Mill.
(1) General Direction.	21,922	009
(2) Public Buildings	77,085	260
(3) Cairo City	27,138	638
(4) Provincial Towns	11,205	393
(5) Scavenging and Watering	28,795	732
(6) Esbekieh Garden	2,327	198
Total.	£E.198,474	230

I will briefly discuss each of the above items:—

(1) *General Direction.* This calls for no special remark, being the salaries of the permanent Staff.

(2) *Public Buildings.*

The following is the distribution of the charges:—

	£E.	Mill.
Temporary Staff.	867	543
General Charges	3,674	163
Materials and Plant.	219	055
New Works.	12,212	944
Repairs and Maintenance.	30,111	555
Total.	£E.77,085	260

Of the above, the most important items are the two last: the others do not vary much from year to year.

New Works.

The amount of money expended upon buildings for the General Government Administrations was as follows :—

	£E.	Mill.
(1) Ministry of Finance	3,352	020
(2) Ministry of the Interior, comprising :—		
Sanitary Service	£E.10,510	719
Prisons	1,872	932
Mudiries, etc.	5,854	294
Quarantine Service	1,400	000
Slaughter-houses	5,000	000
(3) Ministry of Public Instruction	8,063	643
(4) Ministry of Justice	1,335	917
(5) Ministry of Public Works	3,044	884
(6) Repayment of Deposits	1,778	535
Total . . .	£E.42,212	944

The sum for *Repairs and Maintenance* was divided among the different Administrations proportionally and according to urgency. The amount was, however, quite insufficient for the needs of the Services.

(3) *Cairo City.*

The following are the details :—

	£E.	Mill.
Temporary Staff	727	732
General Charges	779	417
Plant and Materials	4,428	788
New Works	1,123	919
Repairs and Maintenance	17,078	782
Total . . .	£E.27,138	638

For the above sum, the whole of the Cairo roads are made and kept in repair; it also includes expenditure upon gardens, trees, etc. Twice this sum would be insufficient to meet the wants of the town.

(4) *Provincial Towns.*

	£E.	Mill.
Temporary Staff	497	391
General Charges	638	178
Materials and Plant	35	896
New Works	1,078	526
Repairs and Maintenance	38,955	402
Total . . .	£E.41,205	393

With regard to the last item in the above, a sum of £E.31,350 was expended by the provincial Municipalities, controlled by a Permanent Committee, composed of Members of the different Government Services interested. The balance of £E.7,605,402 mill. was applied to the wants of the three towns situated on the Suez Canal, viz., Port-Said, Ismaïlia and Suez.

(5) *The Scavenging and Watering Services.*

	£E.	Mill.
Temporary Staff.	456	966
Plant and Material.	4	800
Maintenance.	28,333	966
Total.	£E.28,795	732

(6) *The Esbekieh Garden.*

The whole of the money was expended in maintenance. This will be alluded to later on in this report.

(b)—EXPENDITURE IN 1899, UNDER THE SPECIAL CREDITS GRANTED BY THE CAISSE DE LA DETTE PUBLIQUE.

The following is the distribution :—

	£E.
Cairo Appeal Court and Prison.	30,176
New Arab Museum and Library	10,732
New Egyptological Museum.	51,604
Sundry New Public Buildings.	51,680
Repairs to Ancient Arab Monuments.	3,311
Total.	£E.147,503

I shall have something to say about each of the above later on. The only item to which I will allude just now is the last, viz., the repairs to Ancient Arab Monuments. This money, as I described in my last year's report, is controlled by a special Committee. The money being, however, borne upon the Public Works Budget, the total expenditure must be recorded in any statement of the yearly expenditure of the Department.

(c) SPECIAL CREDITS PROVIDED BY THE OTHER DEPARTMENTS.

The following was the expenditure under this head in 1899 :—

(1) *Finance Ministry.*

	£E.	Mill.	£E.	Mill.
Opera House	579	550		
Abdin Palace	2,168	019		
Post Office	90	324		
Coast Guards	2,311	206		
Customs.	1,522	115		
Printing Office	1,764	301		
Ports and Light houses	1,109	922		
Various Buildings.	1,541	986		
			11,090	423

		<i>Brought forward.</i> . . .		£E.11,090	423
(2) <i>Ministry of Justice.</i>				£E.	Mill.
Tribunals				1,461	895
Various Buildings.				184	238
				<hr/>	<hr/>
					1,346 133
(3) <i>Ministry of the Interior.</i>				£E.	Mill.
Quarantine Service				35,474	332
Police Stations				784	145
Mudirihs				769	517
Disinfection of Cairo City.				7,500	000
Various Buildings				903	584
				<hr/>	<hr/>
					45,432 078
				<hr/>	<hr/>
Grand Total. . . .				£E.57,868	634

Mr. Perry has submitted a note upon the working of his Service. It contains full details of his Administration, and is attached as an appendix to this report. I will briefly discuss those points in it which seem to me to be of general interest.

THE DESIGNING AND ARCHITECTS DEPARTMENT.

The work done by this branch of the Service, in 1899, was as follows :—

Complete designs for 96 Public Buildings, costing £E.296,687, were prepared, and the works put to public tender. The designs for 11 new Buildings, costing £E.114,350, are in preparation. In all, 13,236 plans and copies were produced in the course of the year by Manescaleo Bey and his staff. Mr. Perry draws attention to the great difficulty of finding competent assistants for this Office. This is true, but it is difficult to see a remedy, if young Architects are unwilling to come to Egypt. This Office is greatly overcrowded at present, and finds it difficult, with its existing staff, to keep pace with the requirements of the different Services.

SPECIAL WORKS, LOWER EGYPT.

Sixteen works were taken over from contractors after one year's guarantee. Sixteen more were completed at a cost of £E.76,737.

The principal of these were—the Quarantine Park at Mex, the Quarantine Station at Tor, the Shibin-el-Kom Hospital and the Port-Said Slaughter-house.

The only one of these that calls for any special remark is the Tor Quarantine Station. This was described in my last year's report, and was finally taken over in 1899. The construction of such a complicated work, in so short a period of time and in such a remote spot, reflects great credit upon Mr. Clifton, the Inspector of Special Buildings, and upon the contractors, Messrs. Guetin et Charvaud. A complete water supply and sewage system has been provided.

Three Police Stations in the Provinces, commenced in 1899, will be completed early in 1900. A home was built for the Director of the Medical School at Cairo. The Prisons of Manshia, Tanta and Alexandria are nearly completed.

The principal works in progress are:—

- (1) The New Egyptological Museum in Cairo.
- (2) The Appeal Court and Prison. ..
- (3) The Arab Museum and Library. ..
- (4) The Government House at Port-Said.

The amount of money sanctioned for the above is £E.310,499. Up to the end of the year 1899 a sum of £E.179,445 had been spent upon them. The expenditure for the year was £E.91,248.

(1) *The Egyptological Museum.*

Good progress has been made upon this construction, and it is hoped that it will be entirely completed by the spring of 1901. The roofing was nearly completed in 1899, and the dome should be finished early in 1900. Even after the masonry has been completed, there will be an immense amount of work to be done in the shape of plastering, decorating, etc.

(2) *The New Native Appeal Court and Prison, Cairo.*

These buildings were practically completed in 1899, and were taken over by the Ministry of Justice early in 1900.

(3) *The Arab Museum and Library.*

The foundations of this work were completed before the subsoil water began to rise. The works are progressing very satisfactorily.

(4) *Port-Said Governorat.*

The western wing is completed. The necessary funds having been found, the rest of the building will be proceeded with at once.

SPECIAL WORKS. UPPER EGYPT.

Two Markaz Buildings, five Slaughter-houses and one Dairy for the Agricultural College were completed at a cost of £E.7,458. Nine buildings to the value of £E.27,035 are still in course of construction. They consist of Schools, Markazes, Tribunals, Hospitals and Slaughter-houses. Mr. Hewat, of whose work Mr. Perry speaks very highly, has devoted much time and trouble to preparing type drawings of the different classes of buildings required for each separate Administration: a considerable economy both in design and in preparation of the estimates has resulted.

THE ORDINARY BUDGET.

Works and Repairs.

Lower Egypt.—A sum of £E.51,731 was spent in 1899.

The construction of two new schools, the Dar el Ulm and the Nasrieh, both in Cairo, were confided to this Inspection, Mr. Clifton's time being fully occupied with the special works under his charge. The chief improvements carried out, in addition to the repairs to Public Buildings which call for no special mention, lay in the direction of improving the Provincial Towns. Streets have been widened, Public Squares and gardens introduced, and trees planted along the main thoroughfares.

Upper Egypt.—Total expenditure £E.13,617.

The work done calls for no special mention. It consists almost entirely of repairs. Mr. Perry, in his note, writes at length about the unsatisfactory working of the Local Commissions, and recommends that these bodies should only be allowed to make suggestions as to work, and not allowed to supervise its execution. He further enlarges upon the incompetency of his own Tanzim Staff, stating that not 5 % of his Engineers are capable of estimating or carrying out a single project! This is doubtless true, if Mr. Perry says so, but his service is not the only one in Egypt that suffers from the inefficiency of its subordinate staff. It would be, undoubtedly, economical in the end to pension off all the useless men and replace them by capable ones. Such action is not, however, possible, and nothing remains but for Mr. Perry, and the many competent members of his service, to do the work of the incompetent ones in addition to their own. This is not an ideal

solution of the question, but it is the only practical one under the circumstances.

Mr. Perry draws attention to the fact that rates of construction in Egypt are rising everywhere. This is very noticeable in the case of ironwork which shows a rise of from 30 % to 42 % in the different classes during the last ten months. This is largely due to the rise in the price of coal.

THE CAIRO ROADS.

I discussed the question of these roads at some length in my last year's report. I will therefore allude to them very briefly now, referring anyone desiring further particulars to Mr. Perry's note, which contains much interesting information on this subject.

The general improvement in their construction and maintenance, instituted with the nomination of Mr. Perry to his present post, has been maintained.

775.985 square metres of Basalt roads were added to the road surface of the city in 1899.

81.778 square metres of old limestone road were picked out to a depth 0.08 metres, and re-laid with Basalt. In this last, an economy of 15 mill. per square metre was effected over last year's rates for similar work.

The materials furnished for the Cairo roads, in 1899, were as follows :—

14.266 metres cube of Basalt, extracted from the Abu Zabel quarries by Prison labour.

19.010 metres cube of limestone quarried at Abbassiyeh by piece-work. This cost 14 P.E. per metre cube at site.

THE GHIZEH ROADS.

The area of road-surface on the west bank of the Nile is 211,000 square metres. £E.2,408 was expended on new road-making and £E.560 upon repairing existing roads. Mr. Perry reports that the soft limestone wears better in Ghizeh than in Cairo : presumably because the traffic is less in the former than in the latter area.

THE CAIRO SCAVENGING AND WATERING SERVICE.

I, last year, mentioned that the funds available for this work do not permit of much more than half the area of the city being cleaned and

watered. The most rigid economy is practised by the Service, and the strictest watch is kept over every detail of its working. In this way Mr. Perry has been able to add some 90,000 square metres to his area cleaned : but this is a very small addition, if the total surface of the city be considered.

The total area of the city roads is 2,781,741 square metres. Out of this 1,708,545 square metres were cleaned in 1899, as against 1,619,044 square metres cleaned in 1898.

The rate of clearance has been reduced to £E.17. 272 mill. per square metre, as against £E.18 last year.

Further, an economy of 12,274 metres cube of water has been effected in 1899.

In spite of this, an area of rather over 1,000,000 square metres of road remains in Cairo, which, in ordinary times, is untouched. As these roads are not macadamized, it is easy to imagine their state of filth, more especially after the winter rains, when their surface is a sea of liquid mud. I use the expression, "in ordinary times," because during the presence of the plague in Egypt in 1899, a special credit of £E.900 per month was accorded by the Caisse de la Dette for the clearing of the city. This had an excellent effect while it lasted, but the grant ceased at the end of the year. The rate of £E.17 $\frac{1}{4}$ per square metre of clearance is an extremely low one, being hardly more than half of that expended in the principal towns of Europe and America.

The amount of extra work thrown upon this Service by a few hours' rain is extraordinary. The water lies in the hollows of the street and the basements of the houses in many localities are flooded for days. During the rain which fell in October 1899, 12,158 carts-full of rain water were pumped off the streets, and carried away.

£E.

910 was spent upon new carts in 1899.
1,208 upon repairs.
1,600 upon material.
6,245 upon forage.

This last item shows an economy of £E.665 over the accounts for 1898, although the number of animals was increased by thirty.

The total number of animals now belonging to this Service is 442. The credit of working the Service so economically is largely due to Mr. Powell and his assistant Mr. Fitz-Patrick. The latter officer has written an interesting note upon the Cairo native baths which is attached to Mr. Perry's Report.

THE EZBEKIEH GARDENS.

A good deal was done in the way of general improvements to these gardens out of the funds derived from the gate money. They are now beautifully kept, and have been completely purged of the low-class booths with which they were formerly filled. That the Cairo townspeople appreciate this change is shown by the increased receipts. Thus, the receipts, which in 1897 were only £E.307, increased in 1898 to £E.1,255, and in 1899 to £E.1,390.

The expenditure on the other hand shows a decreasing scale, thus :—

	£E.
Expenditure in 1897	2,758
" " 1898	1,836
" " 1899	1,768

The economy in water is still more remarkable, as the following figures show :—

Water used in 1897	87,024 metres cube
" " 1898	68,045 " "
" " 1899	48,000 " "

The latter amount appears to be amply sufficient for the grass, trees and flowers.

Great praise is due to Mr. Perry and to Mr. H. Curtis for the trouble they have taken in improving these beautiful gardens.

THE HELWAN WATER WORKS.

These works are still run at an increasing profit in spite of increased expenditure :—

	£E.	Mill.
Revenue	2,643	345
Expenditure	1,652	000
Net profit	£E.991	345

The total amount of water supplied in 1899 was 233,810 metres cube. The expenditure in pumping was heavier than usual in consequence of the increased price of coal. A supplementary credit of £E.170 was granted by the Ministry of Finance. The water is supplied to the consumers by metres, of which there are now 470 in use. The price of water is now 10 milliemes per cubic metre, as against 20 milliemes in 1894. A new Reservoir, of 500 metres cube capacity, was constructed, and a large new pump and boiler erected.

THE CAIRO TRAMWAYS.

Mr. Perry gives an interesting note upon the above. Several new lines have been opened, and a code of rules for working them has been prepared and passed by the Mixed Courts.

THE ELECTRIC LIGHTING OF CAIRO.

The chief improvement has been the substitution of subterranean cables for the dangerous over-head wires which used to exist. Owing to the reduction in the rate of electricity supplied, a great extension in its use is taking place in Cairo. Monsieur Jacot, the Government electrician, has been most useful in controlling and supervising the details of this work.

THE GAS-LIGHTING OF CAIRO.

This Service was handed over by the Cairo Gouvernorat to the Ministry of Public Works in 1890. Mr. Perry's Report upon the economies already introduced is well worth reading.

THE STAFF.

Mr. Perry has directed the working of the Towns and Buildings Service in a very able manner. He has a great knowledge of practical detail, and a genius for working economically. He has been well seconded in his Administration by Messrs. Sayyed Bey Choucry, C. Clifton and M. Hewat. Also by Messrs. Reboul and Pastour. I have already mentioned Messrs. Powell and Fitz Patrick and H. Curtis. Many others have done excellent work, whose names cannot be mentioned here without making the list too long a one.

III.—THE SURVEY DEPARTMENT.

The reform, introduced in 1898, of grouping all the different Survey Departments under one control, has given excellent results, both as regards efficiency and economy. The work has been largely increased, and the new arrangement has enabled Captain Lyons to cope with it

far more efficiently than could ever have been possible under the old system. The present Service is divided into five sections:—

- (1) The Triangulation Survey.
- (2) The Revenue and Topographical Survey.
- (3) The Geological Survey.
- (4) The Drawing Office.
- (5) What may be termed the Meteorological Department.

The expenditure of the Survey Department for 1899 was as follows:—

	£E.	Mill.
Permanent Staff	2,606	070
Temporary Staff	101	500
Triangulation	1,835	000
Mapping Department	638	995
Geological Survey	6,583	235
Revenue Survey	7,572	947
Cairo Observatory	68	488
Total	£E.19,406	235

To the above must be added a further sum of £E.16,049,075 mill., placed at Captain Lyons' disposal by the Ministry of Finance for the Revenue or Village Survey. This amount appears in two places in the Public Works Budget, being added in one place and deducted in another. Captain Lyons accounts directly to the Finance Ministry for the money spent. Adding this sum to the ordinary Budgetary expenditure for the year, the total cost of Survey work in 1899 becomes £E.35,446,319 mill.

The following is a brief account of the year's work. Captain Lyons' note will be found among the appendices to my Report.

TRIANGULATION.

The Survey in Garbich was stopped and work transferred to the Fayum Province. The triangulating staff is insufficient to enable this work to keep pace with the requirements of the land-tax re-assessment. In order to ensure accuracy, a most exact triangulation is indispensable. In the Fayum, the major triangulation, consisting of a network of 50 triangles averaging from 8 to 10 kilometres side, was completed, while about two-thirds of the minor triangulation in the same Province has been observed. Efforts are being made to prepare for an extension of work as soon as funds will allow. The Geodetic Base measuring apparatus has been sent to Paris for cleaning, re-engraving, etc. The Committee of the International Geodetic Con-

gress has kindly consented to allow this bar to be compared with the International Standards at the "Bureau International des poids et mesures" at Sèvres. It should be returned to Egypt by the end of the year 1900.

THE RÉVENUE SURVEY.

363,265 feddans were surveyed in the Province of Ghizeh, Gharbiéh and Menutiéh. This area is only about one-third of that surveyed in 1898. The large diminution in the work, done in 1899, is due to a radical change introduced in the preparation of the village registers. The Survey Department has now to compile all documents connected with the measurements of each village. Captain Lyons, in his report, explains the enormous amount of extra work thus thrown upon his Service. The records of more than three-quarters of a million of feddans were, by the new arrangement, returned to the Survey Department for revision and check. This represents 326 villages. By the end of 1898, the records of 116 villages had been revised, representing an area of 367,812 feddans.

NEW SURVEY OFFICES.

Funds having been granted for the purpose by the Ministry of Finance, new central offices were built at Ghizeh. These were completed by the end of the year, and the whole staff was transferred there.

THE DRAWING OFFICE.

This branch is quite unable to cope with the very large amount of extra work entailed by the transfer of the Revenue Survey and the printing of village maps. Funds have been granted to provide buildings for the photographic reproduction of maps, but these cannot be ready until 1901. Until then, therefore, the present difficulties must continue. The scale of village maps is to be increased from $\frac{1}{40,000}$ to $\frac{1}{25,000}$. The sale of maps produced £E.285,320 mill., in 1899.

THE GEOLOGICAL SURVEY.

Four Survey parties were in the field continuously for four months. Two of these were working in the Sinai Peninsula; the other two in the Fayum and in the Nile Valley.

The work in Sinai resulted in many interesting facts throwing light upon the earth movements which were the origin of this Peninsula. The iron and manganese ore deposits in the Wadi Nasb were examined, and their distribution proved to be much greater than was previously supposed. The turquoise mines at Maghara were specially examined and reported on. Good iron ore has been found to exist in the centre of this Peninsula, but the conditions for working it are unfavourable.

In the Nile valley, and in the Fayum, the work was pushed on rapidly. The Nile valley between Assuan and Korosko has been mapped in detail on a scale of 1:100,000. A detailed geological survey of the 1st Cataract was also completed. During the season about 180 field maps were prepared.

Over 3,000 specimens were added to the collection of fossils in 1899, many being of great interest.

THE METEOROLOGICAL DEPARTMENT.

The Abbassiyeh Observatory was transferred to Captain Lyons' charge, in February 1899. All the instruments have been repaired, and some replaced by new ones. Self-registering Thermometers and Anemometers have been set up, and a Recording Barometer ordered, so as to make a commencement of meteorological records in 1900. A Milne's Seismograph, for recording earth tremors, has been installed and has worked well. The Observatory clock was taken to England for cleaning, and in order to have electric contacts fitted to it. It was tried at Greenwich Observatory and, being found satisfactory, was returned to Egypt and mounted as a Standard Mean-Time clock at the Observatory. By January 1900, it was automatically transmitting hourly signals to the central Telegraph station in Cairo. As soon as the necessary connections are made by the Telegraph Administration, it will be possible to drop Time-Balls at Port-Said, Alexandria and Suez. The whole of the instruments have been under the charge of Mr. E. Wade, M.A.

THE CHEMICAL LABORATORY.

During the year 1899, 122 samples of rocks, ores, etc., were examined by the Government analyst, Mr. A. Lucas. A small laboratory has been built and fitted up by the Ministry of Public Works, where samples of building materials, etc., can be examined.

Staff.

It is impossible to exaggerate the good services rendered to Egypt, and to Science, by Captain Lyons. He has organized and worked the different branches of his Service with marked ability. He is gradually collecting round him a very competent staff of scientific men, each expert in his own particular line.

IV. THE TECHNICAL SERVICE.

Again, Mohamed Bey Anis, the very capable Director of this Service, has an excellent record to show for his year's work.

The expenditure in 1899 was as follows :—

	£E.	Mill.
Permanent Staff	5,466	849
Temporary Staff	2,692	572
General Expenditure	516	657
Materials and Plant	9	845
New Works	4,788	127
Total	£E.13,474	053

The above does not include the expenditure incurred by the Government Arsenal. This is a self-supporting institution, and its work will be alluded to later on.

As I mentioned last year, the title of "New Works" in the above list of expenditure is a misnomer. The sum in question represents, for the greater part, the expenditure upon repairs to the Government steamers, and the cost of working them. The following is the distribution of the charges :—

	£E.	Mill.
Cost of working Steamers	1,907	810
Repairs and Maintenance of ditto.	2,821	700
Petty Expenses	58	617
Total	£E.4,788	127

THE GOVERNMENT ARSENAL.

The total output of work amounted in value to £E.23,283. This is distributed as follows :—

	£E.
Public Works Department	18,287
Other Government Departments	671
Army of Occupation	316
Private Individuals	898
Cost of coal, oil, etc.	3,111
Total	£E.23,283

The cost of all kinds of iron-work was increased considerably in 1899, owing to the rise in the price of coal. Anis Bey, in his attached report, gives details as to the different rates at which work has been turned out. The Government Steamers are repaired in the arsenal. A new hull was built for one of these, and a steamer belonging to the Ministry of Interior was purchased for £E.700. Two new barges were commenced. A new sawing machine and roller were erected in the fitting shops. The value of materials bought by the arsenal in 1899 was £E.14,130. Of this £E.4,730 represents the value of materials purchased in Europe, and the balance that bought from local merchants. £E.5,140 was paid for labour.

REGISTRATION AND SUPERVISION OF STEAM ENGINES.

Progress has been made towards improving the unsatisfactory state of the existing law regarding Engine Supervision and registration, to which allusion was made in my last year's Report. The Commission appointed for the revision of its clauses presented its report in 1899. The amended law has been approved by the Legislative Council and now only awaits the ratification of the Mixed Courts.*

Armed with this new law, the Service will be able to do something towards removing the dangers to which the Public is at present liable from the unlicensed and unsupervised steam Engines in the towns of Egypt.

In 1899, 169 licences were granted for Engines, 16 of which were for gas and oil Engines.

147 Boilers were examined and tested. Of these 32 did not pass the required tests for safety.

218 visits of inspection were made by the officer of the Service.

To show how difficult it is to enforce the penalties of the law, at present, it may be mentioned that, out of thirty-one actions brought by the Government against persons working Engine in a dangerous state, fifteen resulted in acquittals, and, in the other twenty-one cases, the fine imposed amounted only to a few piastres.

Three boiler explosions occurred in the course of the year, each resulting in loss of life and injury to limb.

Thirty-five Licences were granted for Irrigation Engines up to the end of 1899; 781 have been delivered in all.

The fees obtained from the above last year amounted to £E.325.

*This has been obtained in 1900.

QUARRIES.

The control and licencing of all quarries now forms a portion of the duties of the Technical Service.

In 1899 the total fees realised were £E.1,789,200 mill.

The total number of licences now stand.

Old licences, <i>i.e.</i> for life	. . . . .	138
New licences, <i>i.e.</i> for ten years	. . . . .	489
Total	. . . . .	<u>627</u>

THE CENTRAL STORES.

Purchases, etc., for the year = £E.1,051,634 mill., of this, £E.917,457 mill. was for instruments and camp equipment.

Goods to the value of £E.1,691,635 mill. were delivered to different Departments.

Staff.

I have already had occasion to allude to the excellent manner in which Anis Bey has controlled his Department. He was ably assisted in his work by Mr. Cecil Crawley, the Inspector of the Steam-Engine Branch. Mr. Henry Curtis's work at the Arsenal (of which he is in charge) was as usual excellent, and to him is in great measure due the success attained by this establishment.

V.—THE MUSEUM AND ANTIQUITIES DEPARTMENT.

In November 1899, Monsieur G. de Maspero took up the control of this Service, a post which he had held some thirteen years previous. The Egyptian Government has much cause to congratulate itself in having been able to induce Monsieur de Maspero to return to Egypt. His fame as an Egyptologist is world-wide and his powers of Administration are very considerable. Already, the Department has felt the benefit of his rule, and good progress may now be looked for in the Service.

Monsieur de Maspero having so lately taken up the charge of the Service, his report of the year's work is necessarily little more than a summary.

The expenditure for the year upon the regular budget was as follows:—

	£E.	Mill.
Permanent Staff.	5,127	706
Temporary Staff.	2,483	254
General Expenditure	2,533	298
Total . . .	£E.10,144	958

	£E.	Mill.
To this must be added the receipts from the Tourist fund .	4,100	982
The entry to Museum	646	100
Sale of Objects	386	790
Total. . .	£E.5,133	872

The money realized from the three last sources does not appear in the annual Budget. It is applied by the Museum Service towards the maintenance, guardianship, etc., of the temples and monuments, and to the necessities of the Museum itself. The expenditure is controlled by a permanent Committee, appointed by the Government for the purpose. To this body, the Director General submits his accounts and his proposed distribution of the expenditure for each year. The receipts from the Tourist Fund are applied solely to the maintenance and repairs of the different monuments. Upon these £E.3,435,360 mill. was expended in 1899, leaving a balance of £E.667,622 mill. to be carried over to 1900.

The following are the chief items of interest in Monsieur de Maspero's note:—

Karnak.

A most regrettable accident occurred in 1899. On the 3rd October, as the flood was falling, eleven of the columns in the great hall suddenly fell. The result was a complete ruin of that portion of the structure, and three of the adjacent columns were so shaken as to be dangerous. Steps were at once taken to minimise the danger, and Mr. Legrain was charged with the task. The work of removing the dangerous columns was carried on in 1900, and a description of it does not rightly come into a report upon 1899. It is enough to say, that it was a complete success, and the greatest credit is due to MM. Legrain and Ehrlich who were charged with this difficult and dangerous job.

The causes of the accident are still more or less obscure, but it seems almost certain that it was caused—first, by the insufficient and badly constructed bases of the columns themselves; secondly, by the whole-sale removal of the earth which surrounded these columns to a consi-

derable height: lastly, by the rise in the river levels, and consequent rise in the sub-soil water, which has taken place since this temple was built. The earth round the columns was removed because the salt contained in it was gradually eating away the stone. The only wonder, as regards Karnak, is that the structure has lasted for so long a time. The weight of the masonry is excessive and is concentrated upon certain small points: there is neither bond nor mortar in the joints, and the soil upon which it stands is in a condition of unstable equilibrium.

The question as to what should be done is a very difficult one, and will require much consideration. Any attempt to rebuild these columns would involve a very heavy expenditure. The most important thing to do at present, is to try and so consolidate those remaining, as to avert the risk of a similar catastrophe. This alone will be a work of immense difficulty and must involve a certain amount of risk to the columns while in progress. The question is being carefully studied. Meanwhile, it has been decided, for 1900, not to attempt to lower the subsoil water by pumping, as has been the case for some years. The month of October, when the flood is subsiding, will be an anxious one, as regards Karnak, for the Museum Service.

Medinet Abou.

The work of restoration of this temple was completed in 1899. The whole temple has been cleared of debris and surrounded by a wall.

Valley of the Kings.

Monsieur Loret continued his researches for fresh tombs. He discovered that of Thothmes I but it contained nothing but the sarcophagus of the King. His mummy has been in the Gizeh Museum since 1886.

Sakkarah.

Monsieur de Maspero has recommenced the plan of exploration which he commenced here in 1886. He describes his proposed system of working in his note.

Many interesting objects were added to the Gizeh Museum, which continues under the very capable direction of Brugsch Bey.

THE MUSEUM CATALOGUE.

Good progress has been made with this very important work. There were several changes in the staff in 1899: Dr. Schaefer replacing Dr. Borchardt; Dr. Lange, Dr. Reisner; Monsieur Lacan, Monsieur Chassinat; and Mr. Edgar, Mr. Quibell. About one-third of this important work has now been printed. It will take very much longer to complete than was anticipated, and will at the same time cost a much larger sum of money than was estimated for. When finally published, few museums in the world will possess such a register.

NEW INSPECTORS FOR THE MUSEUM SERVICE.

Two new posts were created in 1899 in the shape of two English Inspectors. They were filled by Mr. Quibell and Mr. Howard Carter, both of them Egyptologists of renown. Their work consists in looking after the monuments in the provinces.

THE CENTRAL OFFICE.

The expenditure charged to this head is the first item given in Table I of this Report.

The following is the distribution:—

	£E.	Mill.
(1) Permanent Staff	26,875	069
(2) Temporary Staff	1,714	591
(3) General Expenses	4,641	992
(4) Materials, Furniture, etc.	1,613	262
(5) New Works.	9,192	393
(6) Nile Reservoirs.	6,574	456
Total.	£E.50,611	763

The only items requiring explanation are Nos. 5 and 6.

As was explained last year, the item for "New Works," under central office charges, represents expenditure outside the regular Budget subheads, and also the sums granted by the Ministry from the General Reserve for works carried out by other Administrations.

The following is the detail:—

	£E.	Mill.
The Alexandria Pass.	150	—
Salary of Inspector for the Cairo Tramway.	240	—
Cairo Opera House Subvention and Staff.	7,352	885
Maintenance of above	518	528
Arab Monuments	930	980
Total.	£E.9,192	393

As regards No. 6, which refers to expenditure upon certain necessary works in connection with the Reservoirs, not coming within the limits of the contract, the mistake, made in 1898, has been repeated in 1899, viz., the expenditure has been included in the central office charges, instead of being charged against the Irrigation Budget. The cause of this is, that the Budget is printed and published in November of each year, at which time it is difficult to make an estimate for the supplementary works that will be required for the Reservoirs in the year following. The matter is not of much importance, but it would be more regular were this expenditure to be included in that of the Irrigation Service.

THE CENTRAL OFFICE STAFF.

Monsieur Barois, the Secretary General, was promoted in January 1899, to the post of Administrator of the Government Railways. During the years in which we have worked together, Monsieur Barois has always given me the most valuable help and assistance. His place has been filled by Monsieur Nicour Bey, who was for years Engineer in Chief of the Railways, and who possesses a very high training as an Engineer.

I again acknowledge the services rendered by Farid Bey Babazogli, Chef du Service Administratif. They have been invaluable, and it is entirely due to him that the immense mass of correspondence, etc., which passes annually through the offices of this Ministry has been smoothly and regularly carried on.

In the Arabic Office, my own clerk, Abdul-Kerim Effendi has rendered much assistance.

M. Olivier Bey has been of great use to me in preparing the figures for this report.

W. E. GARSTIN.

*Under Secretary of State
for Public Works.*

Cairo, 10th July, 1900.

ADMINISTRATION REPORT
OF THE
IRRIGATION DEPARTMENT IN UPPER EGYPT
For 1899

BY
A. L. WEBB,
INSPECTOR GENERAL OF IRRIGATION, UPPER EGYPT.

ADMINISTRATION REPORT OF THE IRRIGATION DEPARTMENT IN UPPER EGYPT, 1899.

PART I.

IRRIGATION AND DRAINAGE.

SECTION I.—THE NILE.

At the commencement of the year, the level of the river at Aswan ^{At Aswan.} was 0·39 metre above the average of the 20 years, 1873 to 1892, and remained well above during January, February, March and April and was still above on the 10th June, when it fell below for a few days, but from the 18th to 24th June it again rose slightly above. From the 24th June to the end of the year it was very much below the average.

The average lowest gauge is R.L.85·01 (1 p. 14 k.) and occurs on the 26th May; in 1899 the lowest gauge was R.L.85·15 (1 p. 20 k.) on the 1st June.

On the 1st June the gauge was 0·09 metre higher than the average, while on the first day of each of the following months (July, August and September) it was respectively 0·43, 1·76 and 1·33 metres lower. The rise commenced on the 2nd June very slightly, and between that date and the 1st July there was a total rise of 0·54 metre after the usual fluctuations; on the 2nd July the real rise commenced, and continued slowly, with exception of two days in July, till the 15th August. After the 15th August there was a fall during four days of 4 kirats, then the level for the next four days was steady at about 12 pics; from the 23rd August it rose again, and with the exception of a check from the 28th August to the 1st September, the rise continued till the 4th September when the maximum 13 p. 22 k. or R.L.91·67 was reached, which is 1·23 metres below the average. After the 4th September the river fell very rapidly till the end of the year, there being only one small rise of 9 kirats from the 18th to 21st September.

On the 31st December, the gauge was 1·75 metres below the average, and the year 1900 starts with the river at Aswan 2·17 metres lower than on the 1st January 1899.

Briefly, the Nile was above the average throughout the summer months, and the rise was fairly early, but slight. The breaks in the rise at the end of June and July and in the middle of August were bad, whilst throughout the flood the levels were extraordinarily low. The fall commenced very early in September and was unprecedentedly continuous and rapid till the end of the year, when the level was 1·75 metres below the average.

At Asyut.

The following statement shows the average of the daily gauge readings at the head of the Ibrahimiyah Canal during the summer months of 1899 and eight typical years:—

YEAR	AVERAGE DAILY READINGS AT ASYUT DURING				Nature of Summer Levels
	April	May	June	July	
1899	46·50	45·91	45·47	46·52	High.
1897	46·09	45·70	45·66	46·89	do.
1884	46·17	45·68	45·50	46·48	do.
1885	45·52	45·13	44·87	47·25	Fair.
1894	45·26	45·01	45·08	49·13	do.
1883	45·57	45·19	45·03	45·77	Low.
1898	45·42	45·09	44·90	45·84	do.
1889	44·99	44·75	44·57	45·60	Very low.
1892	45·24	44·77	44·58	45·55	do.

The statement shows that the summer levels of the river in 1899 were higher than those of the high year 1897 during April and May, but lower in June and July.

With the exception of the slow rise in July, the year 1899 may fairly be considered as good during the summer months.

The lowest gauge recorded at Asyut during 1899 was R.L. 45·32 on the 10th June, being 0·50 metre higher than that of the previous year which occurred sixteen days later.

From the 10th June to the 10th July there was only a rise of 0·60 metre, but from the latter date the real rise commenced, and continued, with a short break from the 19th to 25th August, till the maximum was reached on the 10th September.

The maximum level attained was R.L. 50·64 which is exactly 2 metres lower than the maximum of the previous year.

The following statement gives the lowest and highest levels recorded above and below the 1st Cataract during the past three years:—

Gauge at the 1st Cataract.

SITE	1897			1898			1899		
	Lowest	Highest	Difference	Lowest	Highest	Difference	Lowest	Highest	Difference
	R.L.	R.L.	R.L.	R.L.	R.L.	R.L.	R.L.	R.L.	R.L.
Philæ . . .	96.56	97.95	7.39	89.74	99.07	9.31	96.70	97.00	0.30
Aswan . . .	85.62	92.80	7.18	84.74	93.63	8.89	87.15	91.67	4.52
Difference	4.94	5.15	0.21	5.00	5.42	0.42	5.55	5.33	0.22

The following statement gives the lowest and highest levels recorded on the different river gauges south of the 1st Cataract during the past three years:—

Gauges at Kerma and Halta.

SITE	1897			1898			1899		
	Lowest	Highest	Difference	Lowest	Highest	Difference	Lowest	Highest	Difference
	Metres	Metres	Metres	Metres	Metres	Metres	Metres	Metres	Metres
Halta . . .	1.86	8.00	6.14	1.09	8.72	7.63	1.46	6.92	5.46
Kerma . . .	1.00	5.67	4.67	0.80	6.47	5.67	0.98	4.80	3.82

During the previous year a gauge was fixed at Khartum and readings recorded from the 15th September to the end of November; readings were resumed at the end of April 1899 and have been recorded throughout the rest of the year.

Gauge at Khartum.

The lowest gauge reading was 0.24 on the 8th May, and the highest 5.37 on the 29th August, the total rise being thus 5.13 metres.

SECTION II.—SUMMER IRRIGATION.

The volumes entering and utilized in the Ibrahimiyyah Canal during the summer months of the last six years, and the low years 1889 and 1892 are given below in cubic metres per second, together with the dates of the complete closure of the Deirut escape:—

YEAR	APRIL		MAY		JUNE		Date of complete closure of the Deirut escape
	Discharge at head	Discharge utilized	Discharge at head	Discharge utilized	Discharge at head	Discharge utilized	
1889	37.1	37.1	32.5	32.5	26.4	26.4	15th Feb.
1892	48.4	48.4	36.1	36.1	29.5	29.5	9th March.
1894	65.1	65.1	58.3	58.3	56.8	56.8	16th March.
1895	121.2	84.2	92.1	87.7	81.7	81.7	12th May.
1896	100.2	86.2	75.7	75.7	64.6	64.6	16th April.
1897	115.4	81.4	100.9	81.4	82.8	82.8	17th May.
1898	62.7	62.7	59.5	59.5	47.3	47.3	26th March.
1899	145.1	96.5	123.5	118.4	83.0	83.0	1st June.

The discharge utilized varies with the discharge available, and, after the complete closure of the Deirut escape, the whole of the available discharge is utilized.

It will be seen from the above statement that the discharges of 1899 are higher than those of any other year of the last decade: they are due, to a great extent, to the very much improved section of the Ibrahimiyah Canal, which was the cleanest on record, and necessitates the smallest quantity of dredging that has ever been done.

The irrigation throughout the summer was carried on without the slightest difficulty: in the Asyut, Minia and Beni Suef Provinces rotations were enforced, more as a safeguard against a late rise than on account of any actual necessity; in the Fayum no rotations were enforced.

Fayum supply. The usual rule was followed of giving to the Bahr Yusuf at Deirut one-fourth of the discharge of the Ibrahimiyah Canal at Deirut plus 100,000 cubic metres.

The lowest discharges of the Bahr Yusuf below Lahm recorded in each of the four years of high and four years of low supply are as follows:—

YEAR	DISCHARGE IN CUBIC METRES PER 24 HOURS	
	High Years	Low Years
1899	25th June, 1,163,409	—
1898	—	2nd July, 1,033,124
1897	15th June, 2,298,067	—
1896	2nd July, 1,620,885	—
1895	1st July, 1,876,264	—
1894	—	900,987
1892	—	584,312
1891	—	615,400

The discharges during the summer months of 1898 and 1899 are as follows:—

YEAR 1898.

DATE.	April 15th	May 17th	June 12th	July 2nd.	July 16th
Discharge in cubic metres per 24 hours	2,953,651	2,481,170	1,560,325	1,033,124	2,561,322

YEAR 1899.

DATE.	April 15th.	May 17th.	June 16th & 25th	July 1st.	July 17th.
Discharge in cubic metres per 24 hours	4,228,456	2,970,259	1,475,529 1,163,409	1,901,017	2,337,467

The area of summer crops in the Fayum during 1899 is, according to the figures supplied by the Chief Engineer, 54,476 feddans, which required 1,361,900 cubic metres per 24 hours, allowing 25 metres cube per feddan; it is, therefore, evident from the above statement that the supply was sufficient, except for a few days before the 25th June, for all requirements: on the 25th June the rise in the river was felt at Lahun, and from that date the supply increased, so that rotations were quite unnecessary.

As noted in last year's Report the Fayum flood supply has been increased by the construction of the regulator and lock at Hawaret El Makta and the removal of the stone "saddles" which formerly existed in the channel of the Bahr Yusuf: the cultivated area, however, has increased in a much greater proportion than the supply, and measures should be at once taken to ensure a sufficient supply of red water for the whole cultivated area.

The cultivated area may be taken as 330,000 feddans, which require, at the rate of 30 cubic metres per feddan per diem, 114 cubic metres per second; the maximum flood discharge at present is 8,000,000 cubic metres per diem, or 92 cubic metres per second. Means, therefore, should be devised for increasing the supply by 22 cubic metres per second; the question is being studied, but the most satisfactory method would seem to be to construct a new channel, taking out from the Bahr Yusuf above the Lahun regulator, to supply the Gharak and Nezzah Canals; and thus leave the existing channel of the Bahr Yusuf for the flood supply of the rest of the canals of the Province. When once this new channel has been made, some of the existing canals can be remodelled, and sufficient water passed down them for all purposes.

In the Asyut, Minia and Beni Suef Provinces rotations were com- Rotations,
menced on the 1st June, and were continued till the 17th July, whilst in the Fayum, as stated above, no rotations were necessary, although notices were issued that they might be enforced at any time, if found necessary.

No difficulty was experienced in working the rotations in the three Provinces of the Nile valley proper.

The Cotton
Crop.

The areas under cotton, irrigated by the Ibrahimiyah Canal, in the past four years are as follows:—

In 1896	. . . . .	75,134 feddans.
In 1897	. . . . .	90,696 ..
In 1898	. . . . .	100,005 ..
In 1899	. . . . .	90,887 ..

The following statement which has been furnished by Mr. Wakeham, agent of Messrs. Carver Brothers in Upper Egypt, shows the out-turn of the ginning factories in the different Provinces during the past seven seasons:—

Province	OUT-TURN IN KANTARS						
	Season 1894-1895	Season 1894-1895	Season 1895-1896	Season 1896-1897	Season 1897-1898	Season 1898-1899	Season 1899-1900
Beni Suef	85,000	120,000	150,000	154,000	178,000	143,000	139,000
Mina	30,000	50,000	82,000	107,000	125,000	74,000	105,000
Fayoum.	75,000	90,000	130,000	138,000	163,000	137,000	170,000
Totals. . . .	190,000	260,000	362,000	399,000	466,000	354,000	414,000
Average price per kantar. . . .	P.T. 210	P.T. 165	P.T. 205	P.T. 205	P.T. 162	P.T. 156	P.T. 205

The following statement gives the areas in feddans of cotton irrigated from the Ibrahimiyah Canal in the different Provinces during the past two years:—

Year	Assut	Mina	Beni Suef.	Fayum	TOTAL.
1898	2,635	19,580	26,253	51,537	100,005
1899	1,874	20,576	22,277	46,160	90,887

The area under cotton was less than in the previous year, being 1,000 and 5,000 feddans less respectively in the Beni Suef and Fayum Provinces: this falling off was due to the very low prices ruling in the previous years. The out-turn was good.

The following statement gives the quantities of cane crushed in the chief factories in Upper Egypt and the out-turn of No. 1 sugar during the past four seasons :—

Sugar-cane.

Factories	Season 1896/97			Season 1897/98			Season 1898/99			Season 1899/00		
	Cane crushed	Out-turn No. 1 Sugar	Percentage	Cane crushed	Out-turn No. 1 Sugar	Percentage	Cane crushed	Out-turn No. 1 Sugar	Percentage	Cane crushed	Out-turn No. 1 Sugar	Percentage
	Kan'tars	Kan'tars		Kan'tars	Kan'tars		Kan'tars	Kan'tars		Kan'tars	Kan'tars	
Dana Saïleh	15,815,112	1,590,352	10.1	14,478,746	1,279,373	8.5	13,083,944	1,275,525	9.2	14,515,565	1,697,560	9.4
Dana Sultan Pasha .	587,162	53,589	9.1	451,190	26,510	8.1	479,822	47,885	9.3	466,027	42,450	9.2
Societe Generale des Sucreurs de la Haute-Egypte . . .	3,799,962	395,551	10.4	5,098,826	494,174	8.9	6,250,720	664,042	9.6	5,978,871	575,169	9.6
Egyptian Sugar and Land Company, . .	—	—	—	—	—	—	51,077	49,328	9.3	594,236	46,080	9.2
Beni Korrah	110,000	14,000	8.3	270,000	18,000	6.7	Nil	Nil		504,347	46,080	9.2
Totals Kan'tars..	20,612,536	2,073,192	10.1	20,208,632	1,689,217	8.3	20,957,441	1,959,776	9.4	21,964,138	2,681,347	9.4

The areas in feddans under sugar-cane irrigated from the Ibrahimiyah Canal in the different Provinces during the past two years are as follows :—

YEAR	Asyut	Minia	Beni Suef	Fayum	Fouai
1898	9,883	35,232	5,383	854	51,352
1899	9,473	33,829	7,082	677	51,061

In the Asyut and Minia Provinces the areas of 1899 are rather less than those of the previous year, while in the Beni Suef Province there is an increase of nearly 2,000 feddans, which partly replaces the reduction of 4,000 feddans under cotton in that province.

In the Asyut Province the Beni Korrah Factory belonging to Mr. Wisa resumed working after being closed for a year.

In Middle Egypt the crop was fairly good both in quantity and out-turn, but in the Kench and Girga Provinces the quantity of cane produced per feddan was lower than usual owing to the very low flood.

Sorghum or
summer durah

The following statement gives the areas of summer durah or “Qedi” grown in the basins of the different Provinces during the year :—

YEAR	AREAS IN FEDDANS IN THE DIFFERENT PROVINCES							
	Aswan	Kench	Girga	Asyut South	Asyut North	Minia	Beni Suef	TOTAL.
1899	3,195	23,331	29,981	10,150	8,572	5,459	7,072	87,766

The area of this most important crop is steadily increasing, especially in the provinces of Girga and Kench. The increase in area in 1899 is a little more than 8 % over the area in the previous year.

The out-turn was good.

Maize and
winter crops

Owing to the very low levels of the river during the flood, a very large area of Nabari was planted on the “Sahels” and Hoshahs of the Southern Provinces ; it is estimated that the area in the 5th Circle and Girga Directorate was 155,000 feddans. The whole of this area was irrigated either from the river or adjoining basins, and owing to the special measures taken, the whole crop was saved, with the exception of a few hundred feddans ; the out-turn was very good.

In spite of the low flood, and the consequent want of good irrigation, the winter crops are excellent, and the out-turn promises to be very good ; the climatic conditions have made up for the poor irrigation.

Duty of water

The total area of summer crops irrigated by the Ibrahimiyah Canal, according to the figures furnished by the Chief Engineers, is as follows :—

In the Asyut Province	25,098 feddans.
“ Minia	66,956 “
“ Beni Suef	33,118 “
“ Fayum	54,476 “
Total.	<u>179,698 feddans.</u>

At the time of the commencement of the rotations in June, the discharge of the Ibrahimiyah Canal was 5,716,224 cubic metres per twenty-four hours, thus giving on the above area, a duty of 31·8 cubic metres per feddan.

The lowest recorded discharges during the year are as follows :—

Ibrahimiyah Canal.

Above Deirut	4,516,128	cubic metres per 24 hours.
Below Deirut	1,992,384	.. .. .
Below Magagah	825,120

Yusufi Canal.

Below Lahun	1,163,409	cubic metres per 24 hours.
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Taking the above areas in the different provinces we have the duty of water in each group, as follows :—

(1) Asyut, Minia, Beni-Suef and the Fayum together.	25	cubic metres per feddan
(2) Minia and Beni-Suef together	19	.. .. .
(3) Beni-Suef alone	21.9	.. .. .
(4) Fayoum.	21.3	.. .. .

Owing to the high supply available these figures are above those of the previous year, except in group (2) where the high duty is not easily explained.

SECTION III.—FLOOD IRRIGATION.

As a separate "Report on the Low Nile of 1899," giving details of the Flood Irrigation in the different systems of basins, will be submitted, it is only necessary in this Report to record the main operations; any one wishing for further information can refer to the detailed Report.

The levels of the Nile at Cairo have been recorded in the Public General Works Ministry throughout the past 100 years, there is no record of ^{character of} the Nile gauge at Aswan earlier than the year 1869.

In 1877 occurred the worst flood ever known; after an interval of eleven years, a bad flood occurred in 1888, upon the levels of which were based the calculations for the "Sharaki" works designed and constructed by Colonel Ross; after another interval of 11 years the flood of 1899 has occurred, worse throughout than that of 1888, and as bad as, if not worse than, that of 1877.

In connection with the "Sharaki Works," Colonel Ross considered the actual duration of a flood to be 40 days, or 16 in August and 24 in September; in years of low flood, however, the "sarf" operations on

which the basin irrigation so largely depends, are affected by the levels of the river till the end of October, so that in comparing the floods of different years, a much longer period must be considered.

After a study of the operations of 1888, and the actual experience of those of 1899, the following statement has been prepared, giving a comparison between the levels at Aswan of the three bad years, of which there are accurate records, the Nile valley being divided into two sections at Sohag town:—

AT ASWAN	GAUGES IN THE YEARS					
	1877		1888		1899.	
	Pics.	Kirats	Pics.	Kirats	Pics.	Kirats
Maximum.	13	10	14	16	13	22
Colonel Ross's mean of 40 days	12	23	13	22	13	—
Mean for irrigation south of Sohag, 11th August to 4th October inclusive	12	19	13	15	12	17
Mean for irrigation north of Sohag, 10th August to 20th October inclusive	12	9	12	23	12	1

From the above statement it will be seen that although the maximum gauge in 1899 was 12 kirats higher than in 1877, yet the mean gauge for forty days was only 1 kirat higher, while for the irrigation operations of the whole flood in the basins south and north of Sohag town the mean gauges were 2 kirats and 8 kirats lower respectively in 1899 than in 1877.

The accompanying diagram shows the Aswan gauges for the years 1877, 1888 and 1899, as well as the mean gauges of twenty years.

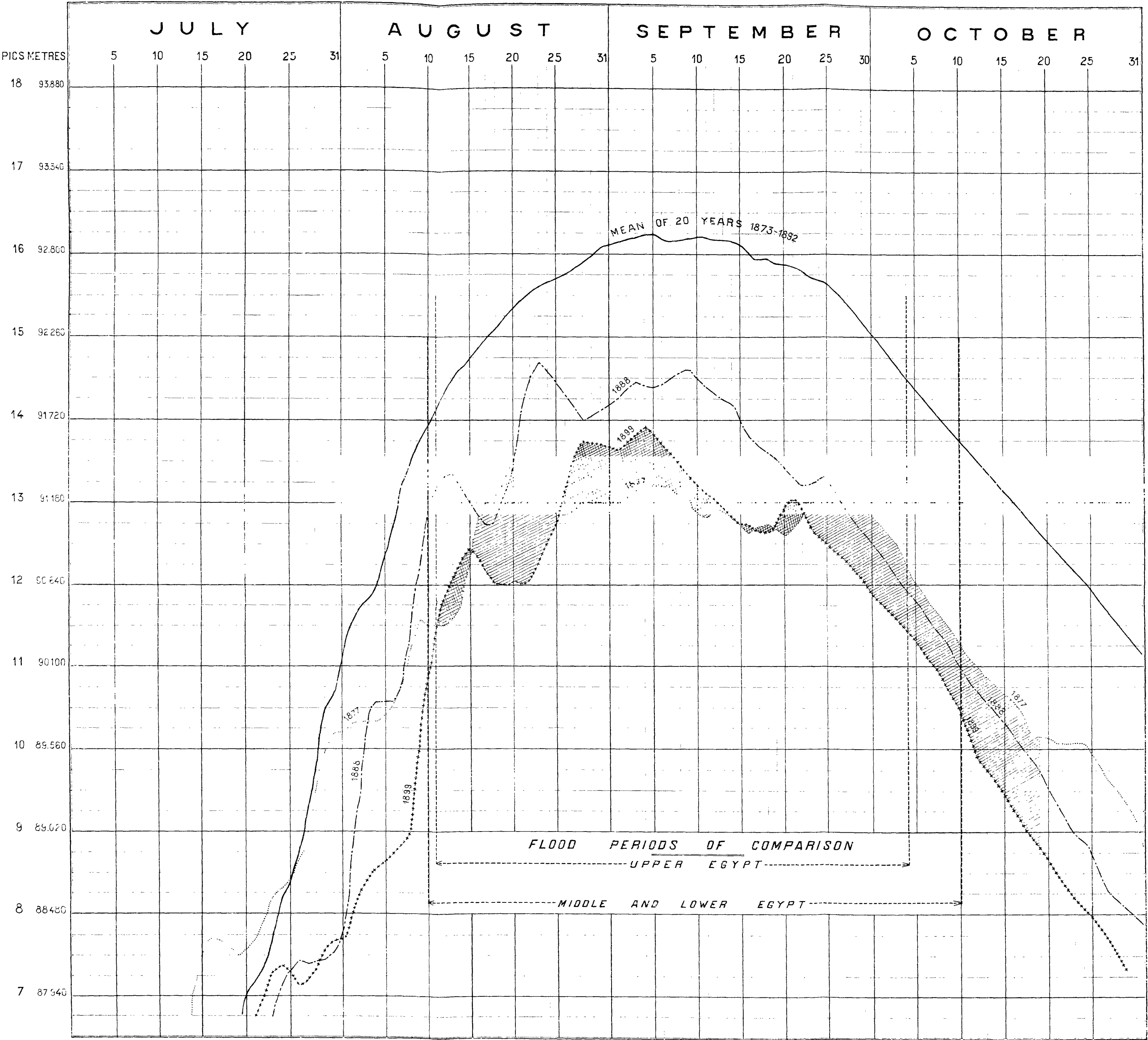
Compared with the previous low floods, the extremely bad features of the 1899 flood were:

- (a) The fall which took place after the 15th August and the very low levels between that date and the 25th August, whereby the sowing of the "Nabari" was much retarded and the cultivators greatly discouraged by the extra lift necessary on their shadoofs.
- (b) The continued and unprecedentedly rapid fall from the 20th September to the end of October, rendering the "sari" operations very complicated and necessitating special measures for the irrigation of the extensive areas of "Nabari" on the sahel and higher parts of the basins.

Opening of the basin—

In the 5th Circle.—Generally, the basins were opened on the 10th August, but some, in which the "Qedi" still remained, were delayed till from the 12th to the 15th August.

GAUGE AT ASWAN



Note: Period during which 1899 was better than 1877 shewn thus

WOPSB

In the Aswan District the feeders of the Khattam and Egli basins did not run until the 24th August, on account of the low levels of the river.

In the Girga Directorate.—Only a few of the basins were opened on the 10th August on account of the Qedi crop; generally, the most of the basins were opened between the 12th and 15th August.

In the 4th Circle.—All the basins were opened on the 10th August, but, owing to the low levels of the river, water did not enter the basins till between the 13th and 17th August.

Even in a year of low flood, when it is important to open the basins early in order to get as much water into them as possible, there is little hope of being able to do so till from the 12th to 15th August in the Southern Provinces, owing to the extensive areas of "Qedi" crops.

The regulators in the Samhud salibah were fully opened in order to draw the water of the Damraniyah Canal into the Beni Himel West basin, but no water reached the regulators, as the branches of the Damraniyah Canal are not connected with the low channels of the Samhud basin. As a basin feeder the Damraniyah Canal is useless, under existing conditions, in years of very low flood; it simply acts as a "Sahel" canal for the "Nabari." The channels of the branches must be continued as far as the Samhud salibah, and a channel also made through the Beni Himel West basin.

The regulators in the Beni Smia salibah and the Gebel Asyut regulator were kept fully opened from the commencement of the flood, and as much water as possible passed northwards. Regulation was not commenced on the Gebel Asyut bridge until the 15th September, when it was necessary to fill Hod Zannar, and keep it as a reservoir for the northern basins, owing to the closure of the Sohagiyah Canal on the 19th September for the purpose of making the "Sadd" at Talihat. In fact, up to the time of the closure of the Sohagiyah Canal the whole of the water of that canal was allowed to pass into Hod Zannar and the northern basins. It may be noted that the masonry cills of the Tissa regulator of the Beni Smia salibah were removed from five of the bays before the flood; moreover, the Mahgar Mangabad regulator, which had been used for some years as a feeder from the Ibrahimiyah Canal, was incorporated with the Mallah salibah, thus giving more waterway for the passage of the Sohagiyah Canal water.

Regulation
between the
4th and 3rd
Circles.

The regulators in the Kosheshah salibah and the El-Komi bridge in Riqqah salibah were left open from the commencement of the flood till the 5th September, when the El-Komi Regulator was closed and water commenced to be stored in Hod Riqqah. It was then arranged that, for the purpose of irrigating the "Nabari Hoshahs" in the Gizeh Province, the Hod Riqqah should be considered as belonging to the Gizeh basins, and the El-Komi regulator thus became under the control of the Inspector of the 3rd Circle, till the commencement of the arrival of the "sarf" waters of the southern basins in Hod Kosheshah on the 4th November, when the Inspector, 4th Circle, took charge of the El-Komi regulator and commenced regulation on it until it was completely closed on the 9th November. On the 19th November the El-Komi regulator was fully opened to complete the irrigation of the Gizeh Province.

Declaration
of Low Nile

As it was evident from the southern gauges that the river at Aswan would not reach the level of 13 cubits on the 15th August, the Ministry declared a "Low Nile" by telegram on the 14th August, according to the rules laid down by Colonel Ross. The declaration was immediately made by telegram to the Mudirs of the Provinces and the Inspectors of the Circles, by whom it was transmitted to their respective staffs. The "Low Nile Distribution" was put in force, and the cultivators warned to sow "Nabari" as much as possible on the "Sahels" and higher portions of the basins; all proprietors of pumping stations on the river were also warned that pumping would have to be continued for the irrigation of their summer crops.

In connection with the pumping concessions granted to the Sugar Companies at Nag Hamadi and Baliana, difficulties arose in August regarding the passage of the pump water into the public channels. According to the terms of the concessions, the public channels can only be used by the Companies up to the time of the entry of the flood water into them: in 1899, however, owing to the very low levels of the flood, it was impossible to give free-flow irrigation to the summer crops along these channels, and consequently special permission was obtained from the Ministry allowing the passage of the pump water into the channels throughout the flood, subject to the condition that any cultivator was free to take water without payment, even when the channels were filled with pump water.

Filling the
basins.

In the 5th Circle.—As far as the levels would allow, the filling was carried out according to Colonel Ross's rules for "Low Nile Distribution";

none of the basins, however, were filled, and the quantity of water which entered them was so small that very little use could be made of the "sarf" water by passing it on from system to system.

In the following basins large areas were left unirrigated, viz:—

In the Bayadiyah system, the Ashshi East and West basins, unirrigated area 6,000 feddans.

In the Shanhuriyah system, the Qift East and West basins, unirrigated area 16,000 feddans.

In the Ghilasi system, the Samata, Dishna and Hamad basins, unirrigated area 17,000 feddans.

In the Sahil Farshut system, the Hew, Raqaiq and Samhud basins, unirrigated area 18,000 feddans.

Nothing short of a barrage across the river near Gebelen will enable these basins to be filled in a very low flood.

In the Girga Directorate.—The filling of the basins was carried out according to Colonel Ross's rules for "Low Nile Distribution," and the reservoir basins of the different systems were fairly well filled before the "sarf": the rest of the basins were filled at the time of "sarf" by passing water on from basin to basin and system to system. With the exception of the Khiyam and Akhmin systems, which must always suffer in low floods, and the southern part of the South Suhag system, in which there were respectively unirrigated areas of 11,000, 10,000 and 20,000 feddans, the rest of the systems were irrigated, though, in many cases, the water remained only a very short time on the land.

In the North Suhag system, more than 40,000 feddans were irrigated by the construction of the "sadd" in the Sohagiyah Canal at Talihat.

In the 4th Circle.—With the exception of a few small basins in the Minia Province, none of the basins in the Asyut, Minia and Beni Suef Provinces were filled until the time of "sarf."

The Asyut basins were filled during the "sarf" operations by means of passing on the Sohagiyah Canal water from basin to basin: the Minia and Beni Suef basins by creating an artificial wave on the Bahr Yusuf.

The basins between the Ibrahimiyah Canal and the river in the Asyut Province were only partially filled: the greater part of the southern basins being left unirrigated.

Although in many cases, especially in the Asyut Province, the water only remained on the land a short time, yet, speaking generally, the basins were fairly well irrigated during the "sarf" operations.

It may be noted that the construction of the Asyut Barrage will, in future low years, greatly facilitate the filling of these basins, as the level at the head of the Ibrahimiyah Canal will be raised by regulation on the barrage.

Sohagiyah
Canal

Sadd at Talihat.—In the low flood of 1888 a “sadd” was constructed in the Sohagiyah Canal, near the village of Talihat, for the irrigation of the basins in the Tahta and Tima Districts of the Girga Province: during their “Sharaki” Mission in Upper Egypt H.E. Mohamed Zaky Pasha, then Minister of Public Works, and Mr. Willcocks, then Inspector of Irrigation, assisted at its construction. The difficulties of the task, and the subsequent rejoicing over the completion of the “sadd” are graphically described by Sir Alfred Milner in his book “England in Egypt.”

In 1899 the “sadd” was again made near the same site: the Inspector General and the Mudir, together with their respective staffs, quickly encamped at the site, constructed the “sadd” in five days and rode away without any demonstration. The head of the Sohagiyah Canal was closed on the morning of the 19th September: on the 20th work was commenced on the “sadd,” and completed on the 25th. On 24th and 25th the head was gradually re-opened, and by the morning of the 26th was fully open.

Four thousand men were employed, working night and day: the quantity of earthwork was 20,600 cubic metres, and the number of sacks used 16,000.

The length of the “sadd” was 163 metres: the maximum head on the “sadd” was 400 metres.

After the completion of the irrigation of the basins on either side of the Sohagiyah Canal, the “sadd” was cut on the morning of the 10th October, and the whole supply of the canal allowed to run into the Beni Smia basin, the whole of which had become practically dry.

In his estimate for the Sharaki Works, Colonel Ross included £E.10,000 as the cost of a regulator of twenty arches of 3 metres in the Sohagiyah Canal to take the place of the “sadd.” The regulator, however, was not constructed on account of want of sufficient funds: the construction is very necessary, the probable cost being from £E.15,000 to £E.18,000.

Discharge of
the basins

In the 5th Circle.—The discharge of the most southern systems of basins was commenced on the 25th September on the west bank, and on the 26th September on the east bank of the river: and it was originally arranged to pass the water on from basin to basin and

system to system to the tail basins Samhud and Hamad. Owing, however, to the very rapid fall of the river, and the consequent daily decreasing supplies in the canals, in addition to the necessity of providing water for the irrigation of the "Nabari," it was seen that the small quantity of water which arrived at the tail basins of the southern systems was barely sufficient to recover the loss in evaporation and saturation: it was therefore found necessary to discharge some of the systems independently, without waiting for the "sarf" water of the upper systems, which was finally stored up and all used in irrigating the "Nabari."

The whole of the "sarf" operations were completed by the end of October: no water was ever escaped into the river, and none was available for passing on into the basins of the Girga Directorate.

In the Girga Directorate.—The commencement and completion of the "sarf" of the different systems were as follows:—

SYSTEM	Commenced	Completed
South Suhag	1st October.	30th October.
North Suhag	5th October.	5th November.
South Assiut, not including Hod i Zinnar.	17th October.	12th November.
Khiyam	5th October.	15th October.
Aklimim	2nd October.	23rd October.
Khizindaria	28th September.	31st October.
Abnoub	14th October.	25th November.

It was originally intended to complete the irrigation of the Khiyam system of basins by means of the water of the "sarf" of Hod Hamad: it was found, however, that the water in that basin was not sufficient for the land depending on it in the 5th Circle, and consequently the Khiyam system, after waiting some time uselessly, had to be "sarfed" independently of the 5th Circle. Similarly, it was intended to complete the irrigation of Hods Beni Himel East and West by means of the "sarf" water of Hod Samhud, this also was found impossible, as the levels in Hod Samhud would not command the land in Hods Beni Himel.

Apart from this miscalculation, which it was impossible to foresee, the "sarf" operations were skilfully carried out, and the very most made of the "sarf" water. The water did not remain long in some of the basins, and the "sarf" of others was late, but on the whole the irrigation was, considering the very low flood, quite satisfactory.

Most of the unirrigated area in the Girga Province was in the Khiyam and Akhmim systems and Hods Beni Himel East and West of the South Suhag system: the remainder was comparatively little.

Owing to the construction of the Sohagiyah Canal "sadd" at Talihat, and for the purposes of irrigation and "sarf," the Hod El-Zinnar was connected with the Asyut-Delgawi chain of basins.

In the 4th Circle.—The commencement of the first and last "sarf" operation, and the completion of the "sarf" of the basins in the different provinces were as follows:—

PROVINCE	Commencement of "sarf" operations.	End of "sarf" operations	Completion of "sarf."
Asyut	1st October.	21st October.	30th October.
Minia	23rd October.	5th November.	15th November.
Beni Suef	5th November.	2nd December.	10th December.

Asyut-Kosh-
eshah system
of basins.

As stated above, the Hod Zinnar was connected with this system of basins for the "sarf" operations.

At the commencement of the discharge of this system, the condition of the basins was as follows:—

Asyut Province.—Hod Zinnar was nearly full, having been kept as a reservoir: the basins between Asyut and Delgawi, with the exception of Hod Muharrak, were very low, notwithstanding that the whole of the Sohagiyah water had been passed into them, and stored up in Hods Beni Rafi and Muharrak.

Hod Ashmunin was fairly full, but Tanuf, Tandah and Itqa were low: the Beni Khaled and Tunah basins on the west of the Yusufi were nearly empty.

Minia Province.—The Menbal basin was full, and the El-Qurn, Tahawi, Deri and Menqatin basins nearly so: the Great Tanashawi basin was low: the Hods Bardanubi and Garnusi very low, and Hod Salaqusi fairly full.

On the west of the Yusufi, the whole of the land was practically unirrigated, and, as the level of the Bahr Yusuf was exceedingly low, the general opinion of the proprietors and cultivators was that the greater part would remain "Sharaki."

Beni Suef Province.—With the exception of Hod Nuerab, which was fairly full, and a part of the new Bahabshin basin, the whole of

the basins were exceedingly low : on the west of the Yusufi also, the land was nearly all unirrigated. As the time of "sarf" approached, the cultivators were very nervous, and generally believed that it would be impossible to complete the irrigation.

In spite of the protests of the proprietors of land in the Hod Zinnar, it was decided to commence the discharge as early as possible.

Asyut Province.—On the 1st October, therefore, the "sarf" operations were commenced by opening fully the Gebel Asyut regulator on to Hod Mellah, and as each basin was filled the water was passed on to the next, till it was finally collected in the Delgawi basin.

In spite of fully opening all the regulators, and making numerous cuts in all the salibah banks, the Delgawi basin was not ready for discharge until the 18th October.

Whilst the irrigation of the basins between Asyut and Delgawi was being effected, the whole of the supply of the Ibrahimiyyah Canal was passed into the Yusufi Canal and the Delgawi basin by closing the rest of the branches at Deirut on the 6th October, in order to help the irrigation of the basins along the Yusufi valley, to fill up the channel of the Yusufi as much as possible, and to assist in filling the great Delgawi basin. All the branches remained closed till the 26th October, with the exception of the Deirutiyah Canal, which had to be opened for two days to complete the irrigation of the Ashmunin basin.

On the 18th October the Delgawi escape was fully opened : between the 18th and 31st October the irrigation of the basins on both sides of the Yusufi was completed and the basins immediately discharged on to the Yusufi by means of their escapes and cuts in their Tarrads so as to create as high a wave as possible.

The artificial wave, on which so much depended, was thus brought to the southern limit of the Minia Province on the 21st October.

Minia Province.—Before commencing the general "sarf" the following preliminary operations were carried out, viz. :—

- (a) On the 15th October, the Menbal basin, which had been brought to its T.R. level on the 13th October, was cut off from the southern basins and discharged direct on to Hods Bardanuhi and Garnusi : this measure, suggested by the Chief Engineer, was taken in order to raise the levels of the Bardanuhi and Garnusi basins which were extremely low, and to avoid the great delay in the general "sarf" which would inevitably occur by depending on the Yusufi wave only ; the result was very satisfactory.

(b) Large cuts were made in the southern ends of the Yusufi Tarrads of the Tanashawi and Bardamuhi basins on the 19th and 26th October respectively.

On the evening of the 23rd October Hod Tanashawi was full, and on the 24th the general "sarf" commenced by discharging this basin on to the Yusufi by means of its masonry escapes and two cuts in the Tarrad. As each basin on the east bank became full, its water was passed on to the next and, at the same time, cuts were made in the Tarrad in order to create the necessary wave in the Yusufi itself. On the west bank, similar operations were carried on, but it was necessary to cut most of the Salibah banks in order to hasten the filling of the basins, and discharge them on to the Yusufi simultaneously with those on the east bank.

It was this simultaneous discharge, which had only been rendered possible by the new banks and masonry works constructed before the flood, that raised the level of the Bahr Yusuf sufficiently high opposite the southern ends of the basins to complete their irrigation.

The "sarf" operations were completed on the morning of the 5th November by the discharge of Hod Shenara.

The artificial wave was thus brought to the southern limit of the Beni Suef Province at noon of the 5th November.

Beni Suef Province.—Before commencing the general "sarf," a large cut was made in the southern end of the Tarrad of Hod Sultani on the 23rd October, in order to allow the Yusufi water to enter the basin freely through it, as well as through the Mazurah regulator.

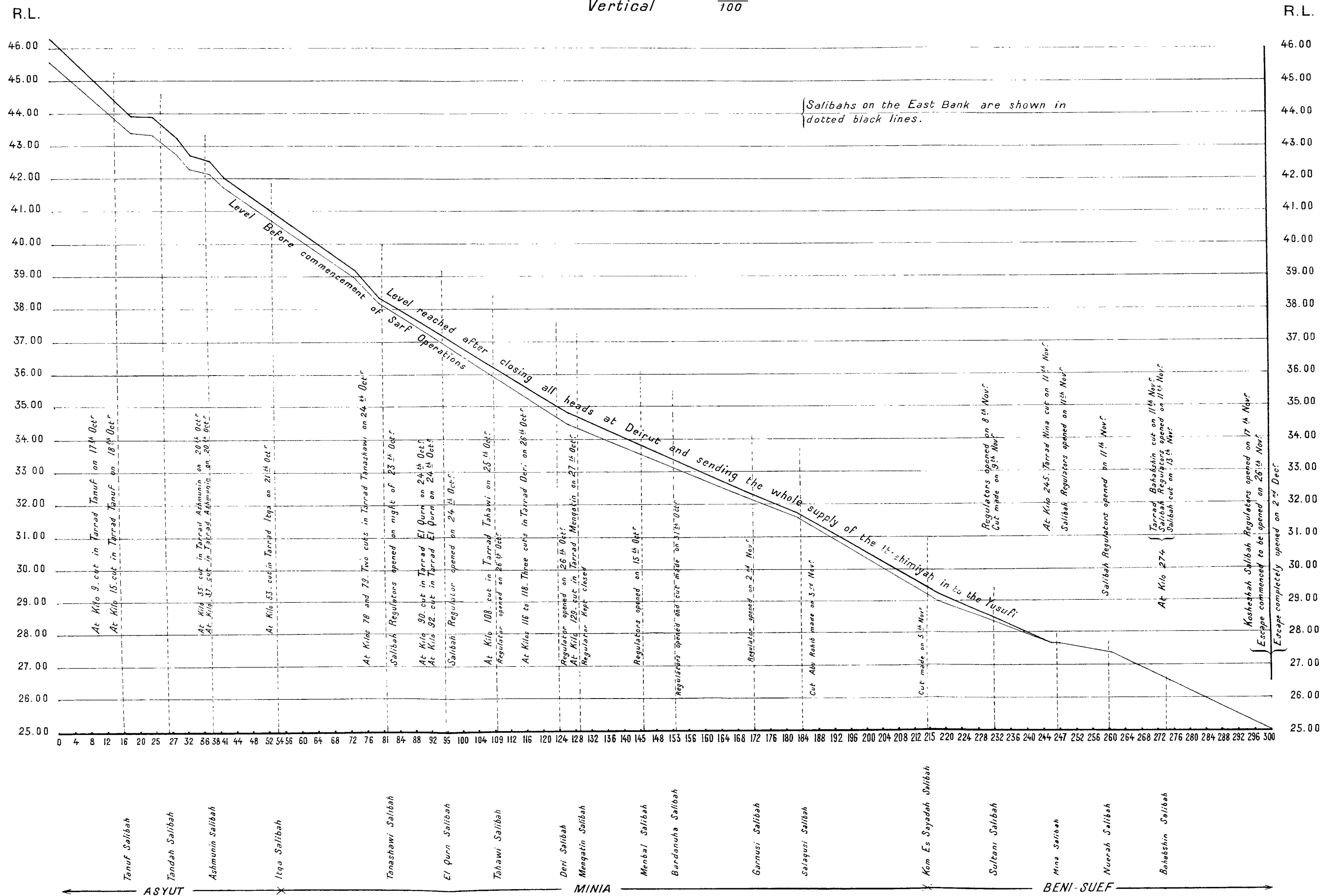
On the 5th November a cut was made in the Kom-el-Saâyda Saliba, and the wave produced by the discharge water of the Minia Province, entered the Sultani basin in great volume. The irrigation of the basins was then completed as far as possible, and on the 11th November the Hods Nina Nuerah and Bahabshin were simultaneously discharged on to the Yusufi and Hod Kosheshah by means of their regulators and escapes and cuts in the Salibahs and Tarrads.

On the 17th November Hod Kosheshah was opened on to Hod Riqqah, and on the 19th November water was discharged on to the Gizeh basins by fully opening the El-Komi regulator and cutting the Salibah bank. On the 26th November the discharge from the Kosheshah escape commenced, and by the 2nd December it was fully opened; on the 2nd December the Attwab escape was also opened.

With the exception of about 6,000 feddans of high land in the basins and on the west of the Yusufi, the irrigation in this province

DIAGRAM SHOWING THE ARTIFICIAL FLOOD IN THE BAHR YUSUF DURING THE DISCHARGE OPERATIONS

Scale Horizontal $\frac{1}{800,000}$
Vertical $\frac{1}{100}$



was satisfactorily completed, and although the date of discharge of the Kosheshah basin was very late, yet the crops are all very good.

The "sarf" operations in the 4th Circle thus occupied two full months, i.e. from the 1st October to the 2nd December, during which time the irrigation of the great Asyut-Kosheshah system of basins, extending over a length of 360 kilometres and comprising an area of 550,000 feddans, was completed by a careful manipulation of the "sarf" water, and sufficient water was also brought down to its northern extremity to complete the irrigation of the basins in the Gizeh Province. The Sohagiyah Canal water, which leaves the Nile 490 kilometres south of Cairo, was passed from system to system until it was discharged into the Rosetta branch 30 kilometres north of Cairo.

The credit for this excellent performance is due to the Chief Engineers of 1st Section Asyut, Minia and Beni Suef, especially the two latter, in whose provinces the operations were numerous and complicated.

Seeing that the levels of the river at the end of October would be extraordinarily low, it was decided at the commencement of the "sarf" operations, that it would be useless to attempt the creation of an artificial wave in the river by the discharge of the Upper Egypt basins: its effect would have been of no practical use either to the East Gizeh basins or Lower Egypt. The Kosheshah escape was therefore manipulated without considering the effect which its discharge would have on the river levels.

On the 15th August the river water passed into the basin through the lower sluices: on the 9th September the lower sluices were closed, the level of the water being R.L. 24.17. The basin was then allowed to rise, but sufficient water had to be passed into Hod Riqqah to supply the demands of the Gizeh Province. On reaching R.L. 25.00 on the 5th October, it was decided to keep it at that level, and to pass the surplus water on to the Gizeh basins through the Kosheshah saliba regulators. On the 7th November the "sarf" water commenced to arrive, and on the 10th November the Kosheshah saliba regulators were closed. On the 16th November the basin level was R.L. 25.16, or 30 centimetres below its T.R. level, and, as no further rise took place, on the 17th November the saliba regulators were opened on to Hod Riqqah.

In the middle of October the downstream cills of the upper platform of the escape were raised to R.L. 24.30 so as to form a deeper cushion of water for the gates to fall into, and also to reduce the head on the

gates at the time of releasing them: the cills were afterwards found useful in moderating the discharge of the upper gates, and had it been necessary, the basin level could have been maintained at R.L. 24.30 instead of R.L. 23.70 after the gates were released, thus guaranteeing the Gizeh supply.

At the end of October, in order to prevent unnecessary strain on the escape a temporary "sadd" was made on the downstream side across the khor leading from the escape to the river, and a temporary spill channel left on the eastern end of the "sadd." The effect of this "sadd" was that the level of the downstream water at the escape never fell below R.L. 23.06, whereas the river at Wastah was R.L. 21.14 on the 25th November, the day before the escape was opened.

On the 17th November the level of the basin was R.L. 26.46 and the river at Wastah R.L. 21.38 or a difference of 5.05 metres, but owing to the temporary "Sadd" the head on the escape itself had been reduced to 3.20 metres: still the "sadd" was only a temporary one and the operation of discharging the huge mass of water from the basin into the river, with a difference of level of 5 metres between them, and at the same time guaranteeing the Gizeh supply, had to be carried out.

As the lower sluices of the escape, when once opened, will not descend against a head of more than 2.50 metres of water, it was evident that by opening them the control of the basin level would be lost: it was consequently determined to commence the discharge by releasing the upper gates.

Owing to the discharge into the Gizeh basins the level of Hod Kosheshah had fallen to R.L. 25.91 on the morning of the 26th November, the river level being R.L. 21.14, and the downstream level at the escape R.L. 23.06: after agreement with Lower Egypt it was decided to open the escape. On the morning of the 26th twenty upper gates were gradually released, the gates falling quite gently into the cushion of water formed for them, and the water pouring over the cills of the upper platform in the form of a cascade; at noon of the same day, twenty more gates were released. On the 1st December, as Gizeh required no more water, the remainder of the upper gates were released, and thirty-two lower gates gradually raised 70 centimetres: on the morning of the 2nd December the remaining twenty-eight lower gates were gradually raised 70 centimetres, and by the evening of the same day the whole of the lower gates were fully opened, the level being R.L. 22.53 upstream and downstream of the escape.

The effect of opening the escape was to arrest the fall of the river and raise the level at Wasta 3 centimetres only.

In the low flood of 1888 it was found necessary to close the heads of the branches of the Ibrahimiyah Canal at Deirut and send the whole of the supply into the Bahr Yusuf and the Delgawi basin for a period of nine days: in 1899 the flood was so much worse than that of 1888 that the period of closure of the branches was twenty days. To stop the flood irrigation of the whole of the "Sefi" area of the Asyut, Minia and Beni Suef Provinces for 30 days in October was certainly an extreme measure which, could only be warranted by such extreme conditions as prevailed in October 1899, but it was the only measure possible for effecting the irrigation of the large basin areas of those provinces. Although in a few places on the Deirutiyah and Saheliah canals, where there is lift irrigation the durah crop was somewhat damaged by the long closure, no harm was done to the flood crops, and the bersim was planted almost as early as usual.

Closure of the
Ibrahimiyah
Canal branches
at Deirut.

Owing to the very low levels, due to the rapid fall of the river during October and November, and on account of the prolonged period of the "sarf" operations until the end of November, many of the masonry works belonging to the basins were severely strained: regulators and escapes had to be kept closed against great heads of water, and in many cases quickly and fully opened to pass on the water.

Accidents
during the
flood.

On the Sohag, Abutig and, Kosheshah river escapes, the head of water was respectively 3.65, 4.43 and 3.26 metres, while on the Ibrahimiyah Canal head regulator at Deirut the head was 1.18 metres.

During the flood the two following accidents occurred, viz:—

The Sohagiyah Syphon.—This syphon which has a length of 117.5 metres, and four barrels each 3.00 metres \times 2.30 metres, carries the high level Girgawiyah Canal under the Sohagiyah Canal channel, near its head at the Sohag town, for the purpose of irrigating the basins and the sahels north of Sohag.

On the morning of the 16th October, during the "sarf" of the South Sohag system, the level of the Girgawiyah Canal at the syphon was R.L. 60.65 and that of the Sohagiyah Canal R.L. 57.57: it was, then, noticed that water was babbling up in the Sohagiyah Canal alongside the extreme edges of the syphon-floor and, on closing off the regulator on the upstream sill of the syphon-well, it was found that the two outside barrels of the syphon had burst and that water was oozing

out at the back of the abutments. Temporary measures were taken to close the outside barrels by means of wooden gates and the two central barrels were kept running, and the floor weighted with an earthen "Saddl" over the top. Sufficient water was thus passed to irrigate the "Nabari," but about 1,200 feddans of basin land were left unirrigated.

A thorough examination of the syphon, after pumping out the water, has since revealed that the whole roof of the syphon over all four barrels was lifted, the abutments and piers being split across as shewn in the accompanying sketch.

The weight of a cubic metre of the masonry taken during the demolition has been found to be exactly 40 cantars or 1,780 kilogrammes. Taking 1,800 kilogrammes as the average weight of a cubic metre, we have:—

$$\begin{aligned} \text{Upward pressure at crown of arch (water)} &= (60.65-54.46) \times 1,000 \text{ kilogrammes} \\ &= 6,190 \text{ kilogrammes per lineal metre} \end{aligned}$$

$$\begin{aligned} \text{Downward pressure on roof (masonry and water)} &= (57.57-56.46) \times 1,000 + \\ &\quad (56.46-54.46) \times 1,800 \\ &= 1,110 + 3,600, \\ &= 4,710 \text{ kilogrammes per lineal metre.} \end{aligned}$$

so that the syphon was burst by the excessive pressure of the water; even had the specific gravity of the masonry been 2 instead of 1.8, the syphon would have blown up.

The whole of the masonry above the level of the cracks in the abutments and piers is being demolished and will be rebuilt before the next flood.

Instructions regarding the gauges to be maintained on this syphon will be issued, so as to prevent a similar accident happening in any future very low year.

The Mâsarrah Escape.—This work, consisting of two vents of 3 metres each, is the river escape for the basins lying between the Ibrahimiyah Canal and the river from Nazali to Deirut.

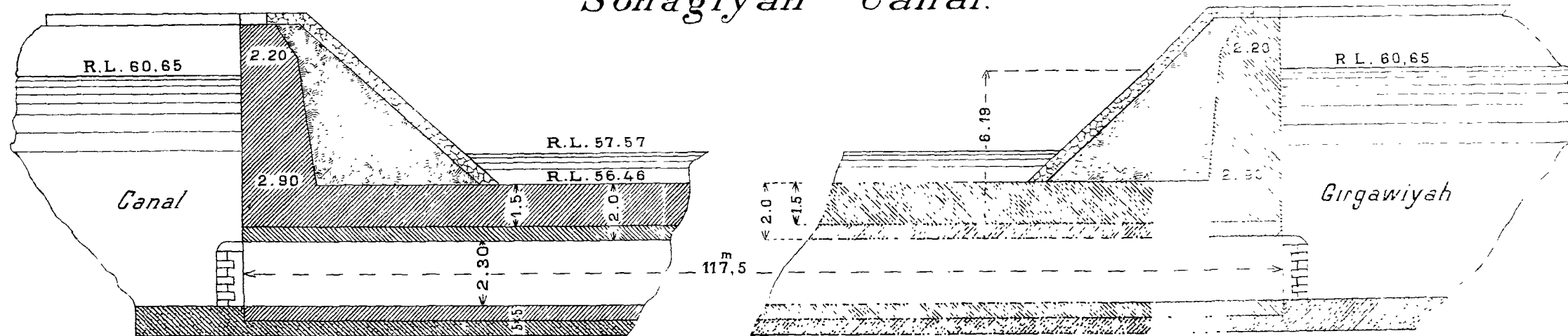
On the morning of the 16th November, the Mâsarrah basin had been filled from the Ibrahimiyah Canal to a level of R.L. 46.25; the escape was then opened to irrigate a small "hoshah" on the sahel of the river outside the escape.

On the morning of the 18th November the hoshah and the Mâsarrah Hod were both at the same level of R.L. 46.25, and the water in the river at R.L. 41.61, or a difference of 4.64 metres; in order to discharge

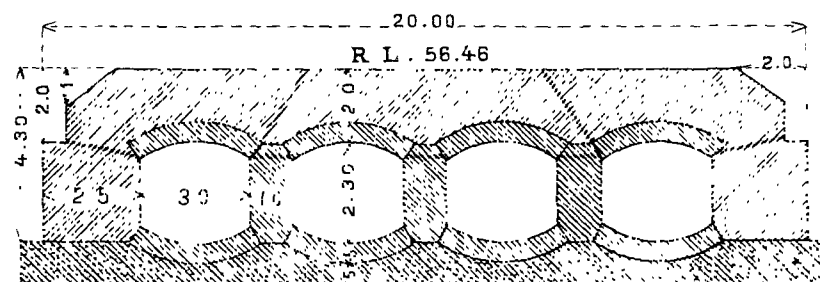
SYPHON UNDER SOHAGIYAH

Scale $\frac{1}{200}$.

Sohagiyah Canal.



Longitudinal Section.



Note. Cracks shewn in red.

Cross Section.

the hoshah, the District Engineer cut its bank at the channel leading from the escape to the river, and immediately there was a rush of water, and a large ravine formed which cut back to the escape itself and undermined it. The escape, which was built in 1898 at a cost of £E.700, was completely ruined: an examination of the ruins shows that the masonry was excellent.

The accident is due to the carelessness of the engineers in discharging a basin into the river, only 300 metres distant, when the difference of levels of the water in the basin and the river was 4.64 metres.

The escape should have been closed before the hoshah was discharged: the hoshah should have been discharged independently of the basin by cutting its bank at a point far from the escape channel: and the escape itself gradually opened.

The experience of the very low flood of 1899 has shown the necessity of carrying out many new works, which would be of great assistance in similar, and also moderately low years. Many of these works are small in themselves and can be carried out gradually from the ordinary annual grants. The following are the most important, for some of which special funds would be necessary, viz.:—

New works
shown to be
necessary by
the flood.

Aswan District.—Deepening the feeder canals, so as to maintain their beds at levels corresponding with 11 cubits at Asswan.

Ramadi System.—Head regulator for the Qandiliyah sayala on the Ramadi Canal, three vents of 3 metres: under construction in 1907.

Head Regulator for the Magnuna Sayala on the Ramadi Canal, one vent of 3 metres: under construction in 1900.

Sahil Farshut System.—Prolongation of the branches of the Dam-raniyah Canal into the Samhud basin to connect with the Samhud salibah regulators.

Killabiyah System.—Regulator in the left bank of the Killabiyah Canal for feeding the Mealla Canal.

Regulator in the Killabiyah Canal, upstream of the Railway bridge No. 23 at Salamiyah, to replace the usual "sadd."

Bayzaliya System.—Escape in the right bank of the Beyzaliyah Canal for the "sarf" of Ashshi East basin.

A project for irrigating the Ashshi basin from the Meallah Canal should be studied.

Shanburiyah System.—Head regulator for the Sheikhiyah Canal.

A project for irrigating the Qift East and West basins from the Bayadiyah Canal should be studied.

Ghilasi System.—Head regulator for the Samata Canal.

Khujam System.—Restoration of the old Hamam bank, and construction of a regulator in it.

Akhmin System.—Remodelling of the Lahaiwa Canal, and Salamuni sayalah, together with the masonry works, to give a larger supply down to Hod Saqulah.

Head regulator for the Shin-shifi sayayalah.

Khizindaria System.—Regulator in the Gebel Haridi Canal, upstream of the Khizindaria syphon, together with the remodelling of the Nawawrah sayalah to complete the irrigation down to the Badari East basin.

Abmuh System.—Restoration of the old Herizat bank, with necessary new regulators.

Head regulator for the Ma'abda Canal.

South Suhag System.—Construction of channels from the Samhud salibah regulators to the Beni Himel West salibah regulator.

Feeder channel for the Um El Tabul Canal from above the Kasra syphon, with head, and syphon under the Kasra Canal.

Feeder head in the right bank of the Kasra Canal to supply Hod Birba East.

Regulator in the Ambariyah sayalah for the direct supply of Hod Menshiyah East, together with feeder head for the same hod.

North Suhag System.—Regulator in the Beni Hilal Canal for the irrigation of high land in Hod Beni Hilal.

Regulator in the Qaw Canal, and feeder heads, for the irrigation of Hod Mi-sha and the Sabil.

Regulator in the Sohagiyah Canal at Taliha.

A-gut-Kosheshah Syste. .—Owing to the decision to convert most of the basins to perennial irrigation, it is not necessary to execute new works, in addition to those now being executed on the Bahr Yusuf: the following, however, are necessary under all conditions of irrigation, viz:—

- (a) Construction of a syphon under the Ibrahimiyah Canal to irrigate the basins between the railway line and the Nile from Asyut to Nazali from the Hod Mallah.
- (b) Construction of a syphon under the Magnunah Canal to carry on the Ibrahimiyah Canal water into the basins on the east of the railway line north of Ashmant.

On the declaration of the bad Nile, all leave was cancelled, and all officials recalled to duty, except those absent out of Egypt.

The Inspectors, 4th and 5th Circles, and the Director of Girga Directorate, as well as the Assistant-Inspector of the 5th Circle were provided with steamers: the Chief Engineers of Keneh, Girga and 2nd Section Asyut were also given steam launches for more rapid inspection: special small dahabiyehs and boats were hired for the other Engineers, and sacks and other materials purchased.

In the 4th Circle and the Girga Directorate Hoshah banks and channels were made on the sahels left unirrigated by the river: the earthwork amounting altogether to 750,000 cubic metres, was done in a short time by contract at a cost of £E.9,252.

The abstract showing the expenditure in each circle is given in Appendix L, the total amount was £E.10,750, which was charged to the special Sharaki credit granted by the Caisse.

In addition to the above £E.409 was paid by the Ministry direct for the hire of steam launches and coal: this was also charged to the special credit.

In the 4th Circle and Girga Directorate £E.643 and £E.354 respectively were provided from the Ordinary Budget and spent on works necessitated by the low flood.

Altogether, the total expenditure was £E.12,146.

SECTION IV.—FLOOD WATCHMEN.

The total number of men called out to guard the banks and bridges during the flood of 1899 was 16,913 men, and the average number of days they remained out was 39: the total number of days' labour was 666,169, or 6,662 men working 100 days.

Special
Sharaki
measures and
expenditure.

The Nile
Corvée.

The following table shows a comparison with the previous six years:—

YEAR	Nature of flood	NUMBER OF DAYS LABOUR IN			Total number of days' labour in Upper Egypt.
		4th Circle.	5th Circle.	Girga Directorate.	
1893	Low.	852,000	255,000	1,018,000	2,125,000
1894	High.	1,255,861	677,835	556,857	2,490,553
1895	Medium.	903,808	334,675	622,485	1,880,968
1896	..	771,212	202,658	488,703	1,462,573
1897	Low.	494,148	196,878	157,465	848,490
1898	Medium.	703,248	146,540	363,262	1,213,050
1899	Very low.	449,155	57,974	159,040	666,169

In addition to the above 54,900 days' labour was used on constructing and watching the "Sadd" made in the Sohagiyah Canal at Talihat: as this was a special work which was not necessary in any of the previous six years, it has been omitted from the above table for the purpose of comparison.

In the 5th Circle, owing to the very low level of the river and the small quantity of water which entered the basins, very few men were employed on the banks: every available man was allowed to go to the "Shadoofs" for the irrigation of the "Nabari."

In the Girga Directorate and 4th Circle, the number of men was nearly the same as in a low year like 1897: no great reduction is possible in very low years, as parts of the Nile banks, and the Sahagiyah and Yusufi Terrads, as well as the banks of the reservoir basins have to be most carefully watched, so as not to risk the chance of a breach, which would be disastrous to a whole system of basins.

In the Minia and Beni Suef Provinces the number was also increased by the calling out of men to watch the newly constructed banks on the west of the Yusufi and the Bahabshin basin, as well as the new bridges in connection with them.

The distribution of the flood watchmen in the different circles is shown in the following statement :—

	RIVER BANKS				BASIN BANKS				CANAL BANKS				BRIDGES				RESERVE		TOTALS	
	Number of men called out	Average number of days out	Length of banks in kilometers	Average number of men per kilometre	Number of men called out	Average number of days out	Length of banks in kilometers	Average number of men per kilometre	Number of men called out	Average number of days out	Length of banks in kilometers	Average number of men per kilometre	Number of men called out	Average number of days out	Length of banks in kilometers	Average number of men per kilometre	Number of men called out	Average number of days out	Number of men called out	Average number of days out
CUTTACK AND PROVINCE.																				
1ST CIRCLE.																				
Bayani		15	38	1	371	95	67	5	64	105							800	8	180	91
Bendi Sudd		1315	30	163	—	111	49	108	1	105	56	1	29	21	7	5	680	3	2115	52
Mina	77	19	1193	58	717	52	196	1	182	59	3	2							5166	26
Ascut North	176	60	1759	12	717	52	196	1	182	59	3	2							3161	11
Total	253	56	33	7	7372	31	762	10	1199	65	371	5	651	69	57	1	1180	15	10355	11
GURGA PUR DISTRICT.																				
Ascut South	183	33	107	5	319	31	76	3	201	31	76	3	192	39	72	3	181	10	1225	33
Gurga	282	28	65	1	1805	30	369	5	524	38	103	7	523	59	180	3			3319	36
Total	765	30	172	5	2155	30	115	5	725	36	179	1	715	51	252	3	181	16	1511	35
5TH CIRCLE.																				
Kenda	—	—	—	—	119	26	79	5					500	63	117	3	533	35	1232	11
Nabha	—	—	—	—	—	—	—	—	32	18	9	3	32	18	9	3	150	10	182	16
Total					199	26	79	5					532	62	156	3	683	25	1114	11
Grand Totals in Upper Egypt																				
	1678	56	205	7	6726	30	1286	8	1924	51	570	1	1808	61	195	1	2317	13	16913	39

SECTION V.—DRAINAGE.

Middle Egypt.—No new drains were made during the year: the main drains are mostly completed but the Daira Sanieh Administration and other proprietors should make a large number of branch drains: a commencement has been made in a few places on the Daira Sanieh property in the Minia Province during the year.

In clearances of drains 234,375 cubic metres of earthwork were executed at a cost of £E.2,755.

As noted in former reports, for two months during the flood there is no outlet for the drainage water under existing conditions. The construction, however, of the Mazurah Regulator and Lock on the Bahr Yusuf will change these conditions, and the regulation on this bridge will afford a means of disposing of some of the drainage water by dropping it into the Bahr Yusuf on the downstream side of the bridge. A project for the necessary channel and masonry works is under consideration.

Although a part of the flood drainage water can be discharged in the Bahr Yusuf below the new main regulators at Nazlet El Abid Sayalah and Mazurah, still pumping stations at the tails of the drains will finally be required in order to lift the balance of the water. The whole subject is under study in connection with the projects for the conversion of the basins to perennial irrigation.

Fayum.—In the Fayum Province the construction of new drains and the remodelling of existing ones are very necessary.

A commencement was made during the year in the preparation of the plans and sections of alterations in old lines, and laying out of proposed new drains in connection with what is known as the Tagin system in the south portion of the Fayum, and work will be started on them in 1900.

In clearance of drains in the Fayum 152,927 cubic metres of earthwork were executed at a cost of £E.2,103, while 23,966 cubic metres were executed in the construction of new drains at a cost of £E.434.

The following table shows the levels of the Lake Qarun on the 1st March for the last sixteen years:—

YEAR.	Levels of lake in metres below sea-level.	Fall in previous 12 months
1885	39·89	Unknown.
1886	40·00	0·20
1887	40·38	0·38
1888	40·73	0·35
1889	41·17	0·44
1890	42·00	0·83
1891	42·78	0·78
1892	43·32	0·54
1893	43·78	0·46
1894	43·84	0·06
1895	44·17	0·33
1896	44·16	0·01 (rise)
1897	44·27	0·11
1898	44·32	0·05
1899	44·25	0·07 (rise)
1900	44·10	0·15 (rise)

The total fall during the last fifteen years has thus been 4·21 metres: the rise during the last two years is probably due to the increased flood discharge and better drainage.

Mr. Willcocks in his "Egyptian Irrigation" in referring to the deficient flood supply of the Fayum Province, states as follows:—
 " Part of this great economy of red water is due to the fact that
 " strenuous efforts have been made in recent years to lower the level
 " of Lake Qarun. I personally consider the lowering of the level of
 " this lake a mistake, when 70,000 acres of land lying many metres
 " above the level of the lake are incapable of being cultivated, because
 " there is no water to irrigate them with." No efforts, strenuous, or
 otherwise, have been made to lower the level of the lake; the lowering is the natural result of the conversion of the basin lands to perennial irrigation, and of the development of the irrigation on the higher plateaus.

No economy of red water has been made in order to lower the level of the lake; on the contrary, the flood supply, though still deficient, has been increased as much as the existing channel of the Bahr Yusuf will allow.

As there is a large area of uncultivated land near the lake, there is no harm done if the level of the lake does rise.

SILARAKI AREAS.

The areas which resulted "Sharaki" in the different provinces after the flood of 1899 are shewn in Appendix N, together with those of the previous bad years 1877-1884 and 1888.

The area left unirrigated after the flood of 1899 was 229,422 feddans but out of this an area of 40,860 feddans was afterwards irrigated from wells, owing to the timely issue of the new "Sharaki" rule by the Finance Department, so that the actual uncultivated area was 188,562 feddans.

In previous years land irrigated from wells after the flood was not considered "Sharaki," but in 1899 it was included with the "whole Sharaki," a measure which the cultivators greatly appreciated.

Comparing the year 1899 with those of previous years, the figures for "whole Sharaki" *i.e.* land left uncultivated, are as follows :—

In the year 1877	753,992	feddans
" " 1884	105,565	"
" " 1888	269,110	"
" " 1899	188,562	"

Considering that the flood of 1899 was as bad as, if not worse than, that of 1877, the above figures show what great improvements have been made in the flood irrigation.

The main credit for these excellent results is due to the late Colonel Ross, whose "Sharaki" works did splendid service, and saved Upper Egypt from distress.



PART II.

SPECIAL WORKS.

(Chargeable to Special Caisse Credit and to Special Grant from Ordinary Budget.)

At the end of 1898 the following statement of proposed expenditure General on special works during the next five years was prepared:—

ADMINISTRATION.	EXPENDITURE IN £E					
	1899	1900	1901	1902	1903	Total
Lower Egypt. . .	200,000	230,000	185,000	133,000	50,000	798,000
Upper Egypt. . .	90,000	150,000	150,000	260,000	450,000	1,100,000
Totals . . .	290,000	380,000	335,000	393,000	500,000	1,988,000

In order to obtain the necessary funds for the above expenditure it was arranged that £E.80,000 should be provided each year out of the Ordinary Budget, from economies in the different sub-heads of the Irrigation Budget, and that the Caisse de la Dette Publique should be asked each year to supply the balance. The £E.80,000 provided out of the Ordinary Budget was to be divided between Lower and Upper Egypt proportionately to the total expenditure proposed for each.

The proposed expenditure of £E.1,100,000 for Upper Egypt was made up, as follows:—

PROVINCE	PROPOSED EXPENDITURE ON WORKS.			TOTAL
	Canals	Drains.	Basins W. of Yusuñ.	
	£E.	£E.	£E.	£E.
Asyut	70,000	25,000	—	95,000
Minia	148,000	65,000	200,000	413,000
Beni Suef	195,000	71,000	—	266,000
Fayum.	82,000	14,000	—	126,000
Totals.	495,000	205,000	200,000	900,000
Add excess on Reservoirs				200,000
Grand Total.				1,100,000

The works proposed in the above statement for Upper Egypt comprised the following:

(a) Construction of basin systems on the west of the Yusufi, Minia Province.

These became necessary on account of the decision to convert the basins of the Asyut, Minia and Beni Suef Provinces on the east of the Yusufi to perennial irrigation after the construction of the Aswan and Asyut Dams.

(b) The conversion of the basins on the east of the Yusufi in the Asyut, Minia and Beni Suef Provinces, to perennial irrigation in order to reap the benefit of the summer supply available from the Aswan and Asyut Dams.

(c) Remodelling canals and drains in the Fayum Province in order to participate in the distribution of the summer supply available from the Aswan and Asyut Dams, and to bring under cultivation the large areas of Khareg-ez-Zimam lands in the province.

Works carried
out in 1899

The Caisse de la Dette Publique having approved of the proposed expenditure for works in 1899, the following amounts were allotted to Upper Egypt, viz:—

	£E.
Special Caisse Credit	60,000
Special Grant from Ordinary Budget.	<u>30,000</u>
Total.	£E.90,000

Appendix F gives a General Abstract of Expenditure on special works during the year. It should be noted that although the total grant for the works was £E.90,000, yet the actual expenditure was £E.89,995: an item of £E.95 was wrongly transferred from the grant under Ordinary Budget.

Appendix G gives the list of the masonry works executed during the year: the total cost being £E.63,689.

Appendix H gives the list of the new and remodelled banks and channels executed during the year, the total cost being £E.17,564.

The projects taken in hand during the year are as follows:—

I.—*West of Yusufi Project, Minia Province.*

The general project, estimated to cost £E.200,000, for the construction of systems of basins for the 70,000 feddans of land on the west of

the Bahr Yusuf, in the Minia Province, was accepted by the Ministry in 1898. Briefly it is as follows:—

(A) *Southern System.*

- (a) Main regulator and lock in the Bahr Yusuf at Nazlet El Abid.
- (b) Construction of Hod Tukh El Khel.
 - Qamadir.
 - Shushah.
 - Tirfa.
 - El Der.
 and necessary masonry regulators, feeder heads, and escapes.
- (c) Remodelling and extension of Canals Zawiyet Hatim and Qamadir.

(B) *Northern System.*

- (a) Main regulator and lock in the Bahr Yusuf at Saqulah.
- (b) Construction of Hod Bortabat.
 - El Qayat.
 - Harikah.
 - Shenarah.
 - Delhanes.
 and necessary masonry regulators, feeder heads, and escapes.
- (c) Remodelling and extension of Canals Kafr-El-Salih and Harikah.

During the year detailed estimates were submitted and sanctioned for the following works:—

- (1) Lock and regulator at Nazlet El Abid.
- (2) Lock and regulator at Saqulah.
- (3) All the canal and feeder heads, regulators in salibahs, and escapes required for the two systems.
- (4) Earthwork for the restoration of the remaining salibahs, excepting Nazlet El Abid, Saqulah and Delhanes.
- (5) Earthwork for the restoration of portions of the tarrads of the basins.

All the above works were put in hand during the year, and very substantial progress made. At the Nazlet El Abid regulator and lock, the foundations, floor, and up and downstream aprons were completed before the flood; work was resumed after the flood, and by the end of the year good progress had been made with the superstructure. Including payments on account of ironwork and materials altogether £E.20,996 was spent: the results of one season's work is highly creditable to all concerned, and especially to Mr. A. G. Sachs, who was in immediate charge throughout.

At the Saqulah regulator and lock, the contractor failed to obtain sufficient labour during the summer months, and consequently did not

succeed in getting in the foundations before the flood. Including payments on account of ironwork, and materials collected, and diversion channel of the Bahr Yusuf, £E.17,000 was spent during the year.

The foundations have since been put in during February 1900.

All the masonry works in the basins, 19 in number, having a total of forty-two vents of 3 metres each, were completed before the flood at a cost of £E.20,492.

The earthwork in 41 kilometres in salibahs, tarrads and channels was put in hand and completed before the flood. Altogether 933,541 cubic metres of earthwork was executed at a cost of £E.12,781.

It is confidently expected that the southern system will be completed for the flood of 1900, with the exception of the stone revetment of the banks, which cannot be done till next year: as regards the northern system, it is doubtful if the Saqulah regulator and lock will be completed sufficiently early before the flood to allow of the diversion of the Bahr Yusuf and regulation on the regulator.

It is most fortunate that these works were commenced this year: the completion of most of the salibah banks and portions of the tarrads, together with all the minor masonry works, before the flood greatly assisted the basin irrigation on both banks of the Bahr Yusuf in the Minia and Beni Suef Provinces: an area of about 40,000 feddans, was saved from being "Sharaki" by their construction.

II.—*Construction of Hod Bahabshin, Beni Suef Province.*

The estimate for the construction of Hod Bahabshin, amounting to £E.13,000, was sanctioned early in the year. The work consists of:—

(a) Earthwork—Construction of Salibah Bahabshin and Salibah Bakir, and the East Yusufi tarrad, a total length of 15 kilometres and containing 382,635 cubic metres, which were executed at a cost of £E.4,783.

(b) Masonry works—Construction of three regulators having a total of eleven vents of 3 metres, and the restoration of the Hariri bridge on the Bahr Yusuf, the whole costing £E.5,201.

(c) Stone revetment of the Salibah banks for which 11,100 cubic metres of stone were collected at a cost of £E.1,830.

The whole of the above works were completed before the flood; the actual packing of the stone revetment will be done after the next flood.

The construction of this basin, separating the southern and high portion of Hod Kosheshah from the rest of the basin, will greatly improve the irrigation of about 26,000 feddans of land: and the banks will define the proposed limit between the future perennial area and the basin lands.

It is again most fortunate that this basin was constructed before the flood of 1899: without it an area of 12,000 feddans would have remained “Sharaki.”

III.—*Remodelling Works.*

(a) Projects Circle :—

In the preparation of the projects for the conversion of the basins on the east of the Bahr Yusuf in the Asyut, Minia and Beni Suef Provinces to perennial irrigation, considerable progress has been made by Ismail Bey Sirri, Inspector of Irrigation, and his staff.

The general lines of the project for the conversion of the Asyut basins, (Tanuf, Tandah, Ashmunin, and Itqa) were approved by the Ministry in June 1899.

Detailed plans and estimates for all the works have now been prepared.

The total cost of the project is £E.120,000 and the area to be converted 52,665 feddans, so that the cost of the conversion is estimated to be £E.2.278 per feddan.

The general lines of the project for the conversion of the Minia basins have been fixed and will shortly be submitted to the Ministry: pending its approval the main lines are being laid down on the ground so that the levels may be taken for the preparation of the detailed plans and estimates.

For the conversion of the Beni Suef basins only the preliminary surveys and levels have been taken.

Fayum Province.—During the year survey parties were engaged in making the necessary plans for the remodelling of the Bahr Nezzah and the El Tagin system of drainage.

Detailed plans and estimates of portions of the works have been prepared, and work has actually started during 1900.

The total expenditure incurred was £E.3.217.

Mazurah Regulator and Lock.—In addition to the above projects, detailed plans and estimate for the construction of a regulator and

lock in the Bahr Yusuf at Mazurah village, near the southern boundary of the Beni Suef were prepared during the year and sanctioned by the Ministry early in 1900.

The object of the work is :—

- (a) To improve the irrigation of the Sultani, Nina and Nuerah basins, the total area of which is 72,000 feddans.
 - (b) To afford a means of disposing of part of the drainage water of the "Sefi" area of the Minia Province during flood.
 - (c) To supplement the flood supply of the future perennial canals required for the conversion of the Beni Suef basins. The contract for the construction of this work, estimated to cost £E.45,000, of which £E.20,000 is to be spent during 1900, has been signed, and work has been commenced in 1900.
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PART III.

WORKS AND ESTABLISHMENT.

SECTION I.—MAINTENANCE AND REPAIRS.

Details of the quantity of earthwork executed during the year and its cost are given in Appendix D. The total quantities are as follows:—

CIRCLE.	BY HAND.		DREDGING	
	Quantity.	Cost.	Quantity	Cost.
	Cubic metres.	£E	Cubic metres	£E
4th Circle	5,431,811	64,875	129,367	4,872
5th Circle	2,048,615	31,190	—	—
Girga Directorate . .	2,671,144	32,074	—	—
Totals. . . .	10,151,570	128,139	129,367	4,872

The average cost of the work done by hand was 1·26 piastres per cubic metre, which is nearly the same rate as that of previous years.

The large amount of works now being executed in Upper Egypt would, therefore seem to have little effect on the annual earthwork rates of the districts, and, though some difficulty was experienced in obtaining labour in the Minia Province for some of the new banks on the west of the Yusufi, the competition of contractors for the district earthworks was as keen as usual.

Dredging the
Ibrahimiyyah
Canal.

The following table shows the quantities dredged and the cost of dredging since the year 1883:—

YEAR	QUANTITY IN CUBIC METRES			COST IN £E
	Asyut to Deirat	Below Deirat	Total	
1884	818,430	330,268	1,148,698	34,656
1885	605,598	182,314	787,912	35,662
1886	461,363	—	461,363	24,429
1887	523,410	—	523,410	26,124
1888	447,088	—	447,088	16,595
1889	629,022	—	629,022	23,071
1890	493,210	—	493,210	18,135
1891	836,116	—	836,116	30,591
1892	413,088	—	413,088	15,597
1893	371,926	—	371,926	14,400
1894	448,026	—	448,026	16,888
1895	351,253	—	351,253	13,225
1896	300,706	—	300,706	11,347
1897	214,212	—	214,212	8,196
1898	247,813	—	247,813	9,374
1899	129,367	—	129,367	4,872

The quantity dredged is far less than in any previous year. This reduction is due not only to the improved section of the canal owing to the construction of the spurs, but also to the formation of the shoal across the mouth of the canal in the river bed, whereby the heavy particles of silt brought down by the flood are prevented from entering the canal, and only the lighter particles now fall as silt within the canal section. The shoal in the river has increased since the previous year, but the draw in the canal kept open a good channel through it for the summer supply.

Although the sections taken during the year 1900 show that the canal bed is in very good order, still the very low levels of the river will necessitate the dredging of a much larger quantity than that shown for the year 1899. The reduction in cubes, however, seems to be fairly permanent under existing conditions of the river, but the changes in the main channel of the river which must eventually take place owing to the construction of the Asyut Barrage and Lock may so alter the conditions as to cause a deposit of heavy particles of silt in the canal, and a consequent rise in the dredging cubes.

Spurs in the
Ibrahimiyyah
Canal.

Only absolutely urgent repairs to the spurs in the Ibrahimiyyah Canal were executed during the year, the amount spent being only £E.71.

The following table gives the progress made in the construction of these spurs and their cost :—

YEAR	Number of pairs of spurs made.	EXPENDITURE IN £			
		On new spurs	On repairs and remodelling	On revetment or railway bank	Totals
1886	12	2,172	—	—	2,172
1887	14	2,290	96	—	2,386
1888	23	3,747	560	1,025	5,332
1889	31	4,366	148	558	5,072
1890	26	4,696	80	710	5,486
1891	32	2,507	295	484	3,286
1892	26	5,191	303	274	5,768
1893	3	1,396	724	35	2,155
1894	9	1,828	847	646	3,317
1895	14	1,938	361	359	2,658
1896	26	1,865	—	125	1,990
1897	—	—	2,400	198	2,598
1898	—	—	1,808	—	1,808
1899	—	—	56	15	71
	246	31,992	7,678	4,429	44,099

No new spurs are necessary, but the existing spurs should be brought to correct section as funds permit.

The quantity and cost of stone used in River Protection Works are as follows :—

	Quantity in cubic metres	Cost in £E
4th Circle	6,868	984
5th Circle	—	—
Girga Directorate.	9,327	1,345
Total.	16,195	2,329

In the Asyut Province 3,000 cubic metres of stone costing £E.467 were used in the repairs to the spurs and revetment in the reach north of Rodah, and the mangabad spurs; in the Minia Province 470 cubic metres of stone costing £E.73 were used in the repairs to the revetment at El Borgaya cemetery, and at Matai; while in the Beni Suef Province 3,398 cubic metres of stone costing £E.444 were used in the spurs north of Wastah.

No new spurs were made in the 4th Circle.

In the Girga Province 500 cubic metres of stone costing £E.80 were used in making a new intermediate spur at Kitkata; in repairs to existing spurs and revetment 1,038 cubic metres of stone were used costing £E.780.

In South Asyut Province 4,489 cubic metres of stone were used, costing £E.564, in repairs to existing spurs and revetment.

In repairs and extension of the river frontages at Girga and Sohag 1,497 cubic metres stone were used costing £E.230; at Asyut 1,855 cubic metres stone costing £E.293 were used in raising and extending the revetment along the river frontage. In protecting the Nile bank at other sites, 1,829 cubic metres of stone were used costing £E.314.

Owing to the very low levels of the river during the flood, little damage was caused to the protection works.

SECTION II.—NEW WORKS AND IMPROVEMENTS.

(Exclusive of Special Works.)

Earthwork. The quantity and cost of the earthwork executed in new channels and banks were as follows :—

CIRCLE.	NEW CHANNELS AND BANKS.	
	Quantity.	Cost.
	Cubic metres.	£E
4th Circle	117,500	1,410
5th Circle	114,337	1,372
Girga Directorate	93,136	1,117
Total.	324,973	3,899

The length of the new channels and banks are given in the following statement.—

CIRCLE	LENGTH IN KILOMETERS.	
	New Channels	New Banks
4th Circle	11,697	15,125
5th Circle	13,170	—
Girga Directorate	19,568	—
Total.	44,435	15,125

In addition to the above a lateral road of a total length of 7.95 kilometres was made along the Kench-Aswan railway line at Redisiyah. The details of the works executed are shewn in Appendix E. from

which it will be seen that no important works were undertaken. The quantity of work executed and the amount spent are, compared with previous years, much smaller on account of the reduction made in the budget grants.

The progress made in revetting basin banks is shown in Appendix K., Basin bank protection which gives also the quantity of stone used and its cost.

The total length of banks revetted was 4,568 metres : 7,195 cubic metres of stone were used costing £E.1,971. The average quantity of stone used per metre was 1.64 cubic metres and the average cost was £E.0.45 per metre.

In addition to the above 5,104 cubic metres of stone were collected at a cost of £E.1,194 for use in 1900. For the revetment of the new Bahabshin Saliba 11,000 cubic metres of stone were collected at a cost of £E.1,830 : this, although included in the Appendix K. is a " Special Work " chargeable to the Special Credit as shewn in Appendix F.

As stated in last year's Report the progress on basin bank protection is much less than in previous years owing to the reduction in the budget allotments.

A list of the new masonry works constructed during the year is given in Appendix B. New masonry works for irrigation (exclusive of special works).

For the improvement of irrigation forty-three works were built at a cost of £E.10,169; of these, thirty-three costing £E.8,951 were for the basins, and ten costing £E.1,218 for the " Sefi " area of the Fayum Province.

In the Asyut Province the head of the Wanli Canal was transferred to the upstream side of the Beni Hussein Canal head regulator and a masonry head built at a cost of £E.380. A feeder head from the Ibrahimiyah Canal for the El Kalbi basin was also built at a cost of £E.735.

In the Minia Province two escapes were built on the east bank of the river in the Sawada Canal system at a cost of £E.1,000.

In the Fayum Province the Nasbah Sanhur and two smaller Nasbahs on its branches were completed at a cost of £E.252, the greater part of the work having been paid for in the previous year.

A new head sluice of the Bahr Seilah, of sufficient waterway for future extensions, and adapted to carry both the agricultural road and the light railway line, was also constructed : the Government share of the cost was £E.500.

Six minor masonry works for the improvement of regulation were built at a cost of £E.466.

In the Girga Directorate three feeder culverts costing £E.595 were built in the Asyut Province.

In the Girga Province a regulator was built in the Salibah Hod Bardsi East at a cost of £E.593, and a feeder head to Hod Beni Himel East at a cost of £E.385. Five small feeder culverts costing £E.799, six small escapes costing £E.1,088 and two sayalah heads costing £E.400 were also built.

In the 5th Circle a head was built to Canal Mealla at a cost of £E.512, and an escape for Hod Dabiyah costing £E.517. Four sayalah heads costing £E.888 and four regulators costing £E.886 were also built.

New masonry
works for
drainage

In the Fayum Province two small works costing £E.115 were constructed for the improvement of drainage.

New buildings

In the 4th Circle an inspection house and stables were built at Wish El Bab, Beni Suef Province, at a cost of £E.446; stables were also built at Abu Rahib and Bardamui rest huts, on the Bahr Yusuf, at a cost of £E.135.

In the 5th Circle two inspection houses with stables were built at Esneh and Quss at a cost of £E.692; seven small store-rooms for regulating plant and materials were also built at a cost of £E.115.

In the Girga Directorate a large central magazine for storing regulating plant and materials was built at Akhmim at a cost of £E.129.

Masonry
works remodelled and
repaired

A list of the masonry works remodelled and repaired during the year is given in Appendix G.

On the Deirut escape £E.275 were spent in repairs to the downstream apron and concrete blocks. This escape is now in very good order, and it is hoped no more concrete blocks will be required after 1900.

In demolishing the towers of the Minia regulator on the Ibrahimiyah Canal £E.130 were spent; a good broad roadway has now been obtained.

In stone pitching in Byaras and repairs to four regulators on the west of the Yusufi £E.659 were spent.

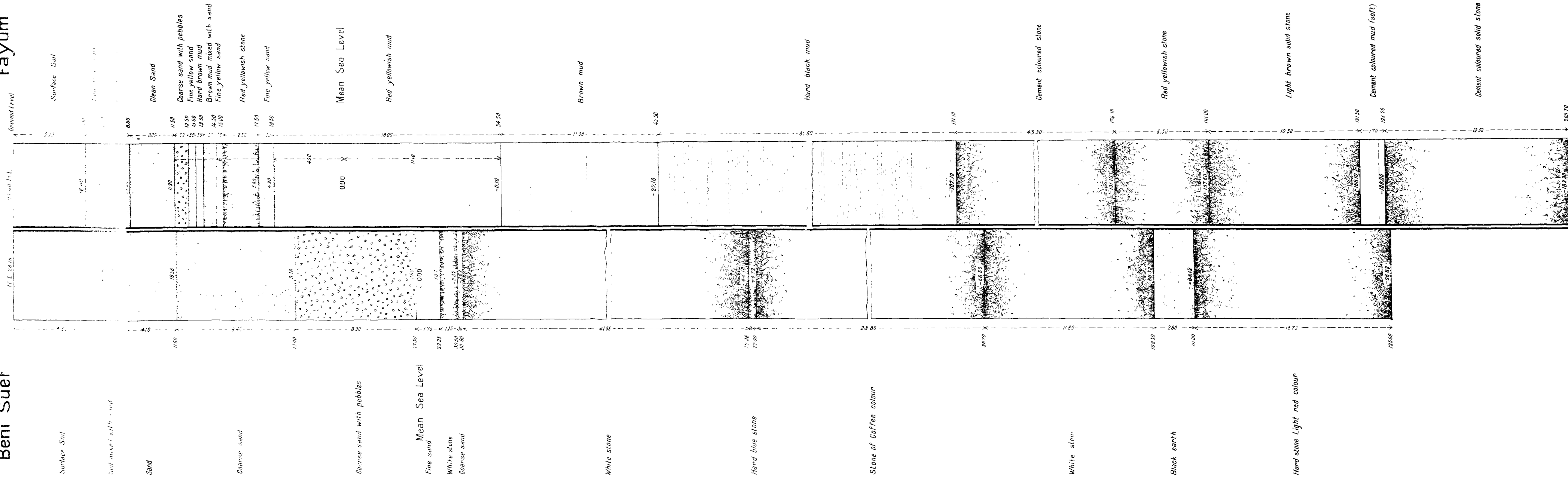
In the Fayum Province eleven masonry works were repaired, and rubble pitching on canals executed, at a cost of £E.1,296.

A payment of £E.1,000 was made to the Fayum Light Railway Co. on account of the Government share of several combined road and rail

Diagram showing the Strata of earth excavated from borings at

Beni Suef

Fayum



bridges on the agricultural roads. A final payment will be made on receipt of the final bills.

In the 5th Circle ten masonry works were repaired or remodelled at a cost of £E.547.

In the Girga Directorate two main regulators were remodelled at a cost of £E.585, and four others repaired at a cost of £E.182.

In fixing angle irons on ashlar grooves of regulators £E.621 was spent.

In repairs to the wooden bridges on the Ibrahimiyah Canal £E.381 was spent.

£E.2,443 was spent in purchase of regulating planks, painting gates, and miscellaneous repairs.

On repairs to buildings £E.200 was spent during the year.

As stated in last year's report, two sets of boring tools were purchased in 1898 from a Vienna firm for the purpose of making trial borings at the towns of Beni Suef, Minia, Kench, and the Fayum, with a view of obtaining good potable water.

trial boring
for the water
supply of
towns.

Fayum Boring.—A commencement was made in 1898 in the Fayum town, and on the 31st December of that year a depth of 147 metres had been reached without obtaining water.

The boring was continued in 1899 and was finally stopped on the 31st July after a depth of 205·70 metres had been reached: no water was obtained.

The reduced level of the ground at the site of the boring is 23·40, and therefore the bottom of the pipes reached 182·30 metres below mean sea-level.

Cost of Boring.

		£E.	Mill.
1898.	Salary of Engineer from 19th May to 31st December .	111	000
	Wages of men in boring and sundries,	99	269
	Store-house for tools,	16	197
	Total to end of 1898,	226	466
1899.	Salary of Engineer from 1st January to end of July .	105	000
	Wages of men and sundries	74	332
	Total cost,	105	798

The cost per metre of boring to end of 1898 was, thus $\frac{226,466}{147} = \text{£E.1. 54}$

The cost per metre for total depth of boring was, thus $\frac{405,798}{205,70} = \text{£E.1. 97}$

both exclusive of initial cost of plant.

Boring at Beni Suef.—When the boring was stopped in the Fayum, the apparatus was removed to Beni Suef and a commencement made there on the 14th August 1899, and after reaching a depth of 125·00 metres below ground level the work was stopped at the end of the first week of March 1900. No water was found. The reduced level of the ground surface at the site of the Beni Suef boring is 28·18, thus the pipes were taken down to 96·82 metres below sea-level.

The cost of the Beni Suef boring was :—

		£E.	Mill.
1899.	Salary of Engineer from August to December . . .	75	000
	Transport of plant from Fayum	15	826
	Wages of men on boring	64	840
	Total to end of 1899. . .	155	666
1900.	Salary of Engineer from January to end of March. .	45	000
	Wages of men on boring	34	995
	Total cost to end of work. . .	235	661

The depth reached being 125 metres, the cost per metre of boring is
 $\frac{235,661}{125} = \text{£E.}1.88$ exclusive of the initial cost of the plant.

A diagram showing the soils passed through in the two borings at the Fayum and Beni Suef accompanies this report. Specimens of the soil of each boring at every half metre of depth have been sent to the Director General of the Survey Department.

SECTION III.—AGRICULTURAL ROADS.

The lengths of agricultural roads completed, with bridges, to the end of the year are as follows :—

Asyut Province	Nil.
Minia	91 kilometres,
Beni Suef	107 ..
Fayum	320 ..
Total.	518 kilometres

No new roads were made in the Asyut, Minia and Beni Suef Provinces during the year.

In the Fayum Province a project for the construction of twenty-eight new roads of a total length of 222 kilometres was accepted by the Provincial Council in May 1898, the estimated cost being £E.22,643. All land, paying a land tax of P.T. 6 and above will contribute P.T. 9½ per feddan, spread over five years, as follows :—

In 1898	1½ P.T. per feddan.
.. 1899	2 P.T. per feddan in each year.
.. 1900	
.. 1901	
.. 1902	

A detailed estimate amounting to £E.4,800 was prepared and sanctioned for some of the roads in the programme, and, a sum of £E.4,150 having been collected, work was started and an expenditure of £E.4,114 incurred during the year. The earthwork of 58·95 kilometres of road was completed, and, that of 10 kilometres more put in hand during the year.

As the bridges on the 58·95 kilometres of roads mentioned above were not completed, this length of new roads has not been included in the length of existing roads at the end of 1899, but will be brought on to the list in 1900.

The amounts spent on repairs to existing roads and rates per kilometre are as follows :—

PROVINCE.	Cost of Repairs	Length in kilometres	Rate per kilometre
	£E.		£E
Minia.	455	91	5·00
Beni Suef	804	107	7·51
Fayum	1,313	320	4·10
Total.	2,572	518	4·96

Thus for a total length of roads of 518 kilometres the cost of repairs is £E.4·96 per kilometre, against £E.4·02 in the previous year.

Fayum Light Railways.—In May 1897, a concession for the construction of 146½ kilometres of light railway lines was granted to the Fayum Light Railway Company, the lines to be completed within two years of the date of the approval of the plans by the Public Works Ministry. Certain modifications and extensions have since been made, and the following is a short summary of the progress made, and the state of the lines at the end of the year 1899.

Line No. 1-2.—From Fayum to Gharak, *via* Miniet-El-Het. Completed during August and opened to traffic on the 1st September 1899.

Line No. 3.—From Fayum to Nezzah, *via* Mutul and Tobhar. Completed and opened to traffic as far as kilometre 21 at Tobhar on 1st September 1899. From Tobhar to the edge of the Wadi Nezzah was finished and in working order by the end of the year, but had not yet been officially sanctioned for traffic.

The original concession for this line was to Nezzah, which is on the other side of the Wadi, but the last kilometre was, by permission,

abandoned because of the very costly bridge necessary to cross the Wady, and an alternate route to Nezzlah, *via* Miniet-El-Het, and Abu Gandir has been proposed, but not yet sanctioned.

Line No. 4.—From Fayum to Lahun.—Completed in July and opened to traffic on the 1st September 1899.

The above three lines have been working with a service of two trains per day in each direction, and are stated to have done fairly well.

Line No. 5.—From Edwa to Tamiyah.—Platelaying is going on satisfactorily and reached kilometre 12 at the end of the year.

Line No. 6.—From Metartaris to Rodah.—Platelaying is going on satisfactorily and reached kilometre 4 at the end of the year.

Line No. 7.—From Fayum to Kalamishah.—Completed during the year, but awaiting official sanction to open to traffic.

Line No. 8.—From Ibshawai to Nezzlah.—Surveyed, but is in abeyance pending sanction being granted for the alternative route to Nezzlah, *via* Miniet-El-Het and west side of Wadi Nezzlah, referred to above.

Line No. 9.—Branch line from Nezzlah to Shawashmah.—In the same condition as No. 8.

Line No. 10.—Circular road from Gebala and Sanouris to Tirsā. For the present it is proposed to complete the portion from Gebala to Sanouris only. The bridges were finished and the earthwork on the embankments, which are considerable, was well in hand at the end of the year, and platelaying was to be commenced at an early date.

SECTION IV.—BRIDGES TO REPLACE FERRIES.

No bridges were built during the year, but an estimate was sanctioned for £E.3,630, and contracts made for four iron bridges over the Ibrahimiyah Canal at Safai, Minia, Hawasliyah and Abu Girg. Work will be proceeded with on them early in 1900.

SECTION V.—SPECIAL SHARAKI CREDIT.

In order to carry out works, necessitated by the low flood, for the prevention of "Sharaki" in the basins and on the banks of the river, a special credit of £E.10,750 was allotted to Upper Egypt.

The following amounts were spent:—

	£E.
4th Circle	4,463
5th Circle	1,351
Girza Directorate	<u>4,936</u>
Total.	£E.10,750

The details of the expenditure are shewn in Appendix L.

SECTION VI.—EXPENDITURE DURING THE YEAR.

An abstract of the expenditure during the year is given in Appendix A ; it was as follows :—

	£E.
Establishment and contingent charges	32,297
Works	278,960
	<hr/>
Total. . . .	£E.311,257

SECTION VII.—ESTABLISHMENT.

Mr. T. H. Clowes was the Inspector in charge of the 4th Circle throughout the year except for the period from the 5th August to the 15th November, when he was absent on leave: during his absence Mr. G. B. Ireland, Director of Works, officiated in charge.

Mohamed Bey Sabri was the Inspector in charge of the 5th Circle up to the time of his death at the end of October: during his long connection with the Irrigation Department he had rendered loyal and excellent service, and had gained the confidence and esteem of all with whom he had worked.

Mahmoud Bey Sidky was in charge of the Girga Directorate till the end of the year, when he was appointed Inspector of the 5th Circle.

Hussein Bey Wassif, Director of Works, was appointed in charge of the Girga Directorate at the end of the year.

Ismail Bey Sirri, Inspector of Irrigation, came from Lower Egypt in February, and was in charge of the Projects Circle till the end of the year.

A. L. WEBB.

APPENDICES.

APPENDIX A.

SUB-HEADS OF BUDGET.	EXPENDITURE.			
	4th Circle.	Gurga.	5th Circle.	Total
	₹E.	₹E	₹E.	₹E.
SUB-CHAP. I.— <i>Establishment.</i>				
Classified	10,213	3,948	4,610	18,771
Hors Cadres	3,763	1,112	1,080	5,955
Total Sub-Chap. I. . .	13,976	5,060	5,690	24,726
SUB-CHAP. II.				
Travelling Allowances	2,879	1,198	1,212	5,289
Telegrams	184	95	263	542
Dahabiyahs.	400	385	612	1,397
Office Rent.	176	62	65	303
Sundries	10	1	29	40
Total Sub-Chap. II. . .	3,649	1,741	2,181	7,571
SUB-CHAP. III.				
Furniture and Instruments.	50	53	197	300
SUB-CHAP. IV.				
New Works	11,943	981	1,075	13,999
Projects Circle.	2,462	—	—	2,462
SUB-CHAP. V.				
Repairs and Maintenance	11,761	5,907	3,137	20,805
SUB-CHAP. VI AND CORVÉE ABOLITION.				
Earthworks and works for decreasing the cost of maintenance of banks and channels.	79,250	37,566	34,184	151,000
Special new works	15,500	—	—	15,500
SPECIAL "CAISSE" CREDIT.				
New Works	60,000	—	—	60,000
NEW AGRICULTURAL ROADS	4,144	—	—	4,144
SPECIAL CREDIT FOR SHARAKI WORKS . .	4,463	4,936	1,351	10,750
Total of Works.	189,573	49,443	39,944	278,960
Grand Totals.	207,198	56,244	47,815	311,257

APPENDIX B.

LIST OF NEW MASONRY WORKS EXECUTED IN 1899 AND THEIR COST. EXCLUSIVE OF SPECIAL WORKS.

NAME OF WORK	Cost	Total per Province.	Total per Circle.	Grand Total per Circle.
	£E.	£E.	£E.	£E.
4TH CIRCLE.				
<i>Works for Improvement of Irrigation.</i>				
ASYUT PROVINCE.				
Culvert in Nile Tarrad north of Um El Qusur	160	1,275		
Head Canal Wanli	380			
Culvert Hod Kalbi.	735			
MINIA PROVINCE.				
(On east of Nile)				
Escape Hod Tehna	570	1,000		
„ „ Hatabah	430			
FAYUM PROVINCE.				
	£E.			
Nasbah Rob El Kebir	198			
„ Sanhur	821			
„ Rob El Sharki	154			
	£E.1,173			
Deduct paid in 1898. . . . „	921	252		
Government share of new head sluice of Bahr Seilah	500	1,218		
Six small masonry works	466			
<i>Drainage Works.</i>				
FAYUM PROVINCE.				
Two small drainage culverts	115	115	3,608	
<i>Buildings</i>				
Rest house and stables at Wish El Bab. . .	446		581	
Stables at Abu Rahib and Bardanuhi . . .	135			
				4,189

LIST OF NEW MASONRY WORKS EXECUTED IN 1899 AND THEIR COST,
EXCLUSIVE OF SPECIAL WORKS—*continued.*

NAME OF WORK	Cost	Total per Province	Total per Circle.	Grand Total per Circle.
£E.	£E.	£E.	£E.	
5TH CIRCLE.				
<i>Works for Improvement of Irrigation.</i>				
KENA PROVINCE.				
Adayma sayala head	259			
Mealla Canal head	612			
Akalta escape, Hod Dabiyah	517			
Khawaga sayala head	170			
Ranan Canal escape on Bakhani's sayala .	248			
Bayadiyah Canal junction.—Ash-shi West basin	401			
Mekhammasat sayala head	232			
Binud Ashraf hoshah culvert	129			
Der Ballas sayala head	227			
		2,795		
ASWAN PROVINCE.				
Ramadi South saliba culvert	108	108		
<i>Buildings.</i>				
Rest-house at Esna	300		2,903	
" " at Quss	285			
Stables at Esna and Quss	107			
Seven small store-rooms for materials and regulating plant	115			
		—	807	
GIRGA DIRECTORATE.				
<i>Works for Improvement of Irrigation.</i>				
GIRGA PROVINCE.				
Culvert Sahil El Hawawish	151			
" " Lambir	117			
Escape Hoshah Arab Bakhwag	161			
Hod El Balabish sayala head	258			
Feeder head Hod Beni Himel E.	385			
Escape Hoshah Sheikh Zein Din	212			
Sahil Khiyam sayala head	142			
" " Culvert	163			
Escape Hoshah El Assirat	245			
" " Kawamil	181			
Awlad Salim culvert in salibah Khiyam .	167			
Ratib Pasha " " " " " " " " " "	201			
Regulator Salibah Hod Bardis E.	506			
Escape Hoshah Bala-fura	156			
" " Banga	133			
		3,178		
				3,710

LIST OF NEW MASONRY WORKS EXECUTED IN 1899 AND THEIR COST,
EXCLUSIVE OF SPECIAL WORKS—*concluded*.

NAME OF WORK	Cost	Total per Province	Total per Circle.	Grand Total per Circle
	£E.	£E.	£E.	£E.
<i>Brought forward.</i> . . .	—	3,178	—	—
2ND SECTION—ASYUT PROVINCE.				
Sahil Beni Mohamed culverts	233			
„ Tawabia culvert	282			
Culvert Hawash Asyut	80	595	3,773	
<i>Buildings.</i>				
Akhmim store	129		129	3,902

ABSTRACT.

	£E.
4th Circle.	4,189
5th Circle.	3,710
Girga Directorate	3,902
Grand Total for Upper Egypt. . .	<u>£E.11,801</u>

APPENDIX C.

LIST OF MASONRY WORKS REPAIRED AND REMODELLED IN 1899 AND THEIR COST.

NAME OF WORK.	Cost	Total per Province	Total per Circle	Grand Total per Circle
4TH CIRCLE.	£E	£E	£E	£E.
ASYUT PROVINCE.				
Repairs to Sahelyah escape	151	1,011		
.. to Deirut escape	275			
Metalling roadway over Deirut bridges . .	132			
Miscellaneous repairs to regulators . . .	450			
MINIA PROVINCE.				
Demolition of towers on Minia regulator .	130	1,250		
Repairs to wooden bridges on Ibrahimiyah Cl.	194			
Repairs to Abu Shushah syphon	95			
Miscellaneous bridge repairs	181			
Repairs and pitching at regulators on west of Yusufi.	650			
BENI SUEF PROVINCE.				
Painting Kosheshah gates	229	700		
Repairs to wooden bridges on Ibrahimiyah Cl.	200			
Miscellaneous bridge repairs	271			
FAYUM PROVINCE.				
Purchase of bricks	350	2,296	5,257	
Revetment in Bahr Yusuf	200			
.. in branch canals	200			
Repairs to nasbahs and regulators	272			
Remodelling four masonry works	197			
Additions to Hawarah regulator and lock .	77			
Part payment of Gov. share of combined road and rail bridges	1,000			
Fixing angle irons on ashlar grooves in reg- ulating bridges Asyut, Minia and Beni Suef Provinces	417		417	5,674
5TH CIRCLE.				
KENA PROVINCE.				
Remodelling Rabâ culvert	92			
.. Kasama bridge	41			
Repairs to Um Adas regulator and syphon .	102			
.. Kom Bilal culvert	32			
Carried forward	270			

LIST OF MASONRY WORK REPAIRED AND REMODELLED IN 1899 AND THEIR COST—*concluded*.

NAME OF WORK	Cost	Total per Province	Total per Circle	Grand Total per Circle
	£E.	£E.	£E.	£E.
<i>Brought forward</i>	270			
Repairs to Matrah-el El Zawaida culvert. . .	40			
.. Tower el culvert.	33			
.. Qift East regulator	41			
.. Gabalaw escape	72			
.. Abu Homar siphon	35			
.. Tarik Inspection House	56			
Purchase of regulating planks and materials for regulators	554			
Miscellaneous repairs to masonry work. . .	378			
ASWAN PROVINCE.		1,479		
Remodelling of Elway culverts at Redisiyah.	52			
Miscellaneous repairs to masonry works . .	99			
		151	1,630	1,630
GIRGA DIRECTORATE.				
GIRGA PROVINCE.				
Remodelling Sakula salibah regulator . . .	368			
Repairs to Kusi regulator.	48			
.. Awlad Salim culvert.	51			
Remodelling Beni el Salibah regulator . . .	217			
Repairs to Isawiya siphon	22			
Purchase of regulating planks and materials.	287			
		993		
2ND SECTION.—ASSUA PROVINCE.				
Alteration of cells on Beni Sina regulator .	61			
Purchase of regulating planks and materials	53			
		154	1,117	
Fixing angle-irons on asulam grooves of regulating bridges in Girga and Assua Provinces	204			
			204	1,351

ABSTRACT.

	£E.
4th Circle	5,674
5th Circle	1,630
Girga Directorate	1,351
Grand Total for Upper Egypt . . .	<u>8,655</u>

APPENDIX D.

FRAMEWORK CHARGED TO REGULAR AND CORVÉE BUDGETS, UPPER EGAR, 1899.

Province.	Repairs to banks	Clearance of Nth canals and drains	Clearance of 5th canals	Clearance of 5th drains	Closing cuts	Adds in canals	New canals and banks	Repairs to agricultural roads.	Total	Cost
	C.M.	C.M.	C.M.	C.M.	C.M.	C.M.	C.M.	C.M.	C.M.	£L.
1st Circle.										
Fayum		5,555	312,616	176,807	11,430		50,381		589,878	8,245
Beni Suef	121,112	332,117	507,652	106,374			13,911	55,876	1,467,736	16,560
Minia	1,095,289	51,580	576,870	128,201	75,606		69,865	91,013	2,091,145	25,262
Assut North.	601,769	463,047	193,629		6,905		71,101		1,282,752	11,800
Dredging Ibrahimiyah Ch.			129,365						129,365	1,872
Total, 1st Circle . . .	2,121,506	795,622	1,750,134	111,168	96,941		238,591	116,910	5,561,178	69,747
Girga Directorate.										
Assut South.	118,111	129,625			279	386			818,701	8,967
Girga.	606,200	1,086,951			7,381	10,123	111,773		1,822,110	23,107
Total, Girga Directorate.	1,024,620	1,516,576			7,663	10,509	111,773		2,671,111	32,071
5th Circle.										
Kena	391,746	1,089,118			1,173		81,125		1,567,521	21,158
Nubia.	79,947	346,156			2,946		52,046		181,091	7,662
Total, 5th Circle . . .	171,687	1,426,576			7,119		133,171		2,018,615	31,190
Grand Total	3,620,811	3,738,776	1,750,134	111,168	111,723	17,571	183,568	116,910	10,280,937	133,011

APPENDIX E.

STATEMENT SHOWING THE NEW BANKS AND CHANNELS MADE IN 1899.
EXCLUSIVE OF SPECIAL WORKS.

NAME OF WORK	Length in kilometres.	Quantity of earthwork.	Total quantity.
4TH CIRCLE.		c.m.	c.m.
ASYUT PROVINCE.			
Diversion of head of Canal Wandli.	0.281	7,460	7,460
MINIA PROVINCE.			
Extension of East Nile barrad north of Minia	9.000	48,940	48,940
BENI SUEF PROVINCE.			
Banks of Hoshahs Attwab and Riqqah	6.000	17,960	24,014
Canal Tezment	2.500	6,054	
FAYUM PROVINCE.			
Four small drains	8.916	23,966	37,086
Diversion of head of Bahr Seilah	0.125	13,120	
Total, 4th Circle.	—	—	117,500
5TH CIRCLE.			
KENA PROVINCE.			
Prolongation of Kommer sayala	4.731	9,719	62,291
" Masraf Danfiq	1.020	17,758	
" Matrabet El Zawaida sayala	3.956	23,698	
New sayala in Der Ballas basin	1.321	11,116	
ASWAN PROVINCE.			
New lateral road at Redisiya	7.950	41,497	52,046
Sarf channel from Ramadi S. to Ramadi N. basin	2.112	10,549	
Total, 5th Circle.	—	—	114,337

STATEMENT SHOWING THE NEW BANKS AND CHANNELS MADE IN 1899,
EXCLUSIVE OF SPECIAL WORKS—*included*.

NAME OF WORK	Length in kilometres	Quantity of earthwork	Total quantity.
		C. M.	C. M.
GIRGA DIRECTORATE.			
GIRGA PROVINCE.			
Prolongation of Sayaler El Agami,	5.530	22,995	
Sayala Sahel Awlad Khalaf	2.099	9,887	
„ „ Hod Kitkata West	2.290	9,233	
„ „ El-Hawawish	3.500	22,842	
„ „ El-Sawaama	2.603	12,239	
Prolongation of Sayalet Baga	1.856	8,471	
New channel in Hoshet Sheikh Zein Dm.	0.550	4,060	
Prolongation Sayala Hoshet Arab Bakhwag.	1.140	3,409	
			93,136

ABSTRACT.

	Cubic metres.
4th Circle.	117,500
5th „	114,337
Girga Directorate	93,136
Grand Total.	324,973

APPENDIX F.

GENERAL ABSTRACT OF EXPENDITURE ON "SPECIAL WORKS" CHARGED TO SPECIAL CAISSE CREDIT AND SPECIAL GRANT FROM ORDINARY BUDGET.

NAME OF WORK	EXPENDITURE			
	Ordinary Budget	Caisse Credit	Total	Total per work.
	£ E.	£ E.	£ E.	£ E.
4TH CIRCLE.				
A.—West Yusuḡi Project, Minia Province.				
Regulator and lock at Nazlet El Abid .	8,000	12,996	20,996	72,813
“ “ Saqulah	7,500	9,500	17,000	
Masonry works in basins	4,728	15,764	20,492	
Earthwork	5,585	7,196	12,781	
Land for Nazlet El Abid	—	504	504	
“ Saqulah	—	1,040	1,040	
B.—Construction of Bahabshin basin, Beni Suḡ Province.				
Masonry works	—	5,201	5,201	13,000
Earthwork	—	4,783	4,783	
Stone revetment	—	1,830	1,830	
Land	—	1,186	1,186	
C.—Remodelling Works.				
Project Circle—Surveys	—	2,905	2,905	3,217
Fayum Province—Surveys	—	312	312	
D.—Purchase of Steam Launch				
	875	—	875	875
Grand Totals	29,905	60,000	89,905	89,905

NOTE.—Actual total grant was £E 90,000, but £E 95 was wrongly transferred from Ordinary Budget, hence total expenditure is £E 89,905.

APPENDIX G.

LIST OF MASONRY WORKS EXECUTED UNDER "SPECIAL WORKS" GIVEN IN APPENDIX F.

NAME OF WORK.	No. of LIGHTS or PIERCINGS	Cost		
		Per Work	Total	Grand Total
		£ E.	— £ E	— £ E.
A.—WEST OF YUSUFI PROJECT.				
Regulator and lock at Nazlet El Abid (under construction) part payment	20	20,614		
Regulator and lock at Saqulah	20	16,650	37,264	
<i>Masonry Works in Basins.</i>				
Zawiyet Halim Canal head	3	995		
Regulator in Salibah Tukh	3	1,296		
Culvert in Salibah Tukh	1	832		
Feeder head Hod Qamadir	2	1,016		
Head of Canal Qamadir	2	796		
Feeder head Hod Tirtfa	2	960		
Escape Head Tirtfa	1	1,020		
Feeder head Hod el Der	2	1,026		
Nazlet Es Sab Canal head	3	1,108		
Regulator in Salibah Bortelat	3	1,232		
Head of Canal Kafir El Salihin	1	591		
West regulator in Salibah Qayar	2	1,956		
East regulator in Salibah Qayar	2	1,242		
Head of Canal Hariqah	3	1,382		
West regulator in Salibah Hariqah	1	710		
East regulator in Salibah Hariqah	4	1,556		
West regulator in Salibah Shenara	1	760		
East regulator in Salibah Shenara	5	2,006		
Delhanis salibah escape	1	729	20,492	
<i>Buildings.</i>				
Quarters for staff and Inspection House at Nazlet El Abid		382		
.. .. . Saqulah		350	732	
B.—CONSTRUCTION OF BAHAFSHIN BASIN.				
Regulator No. 1	3	1,120		
.. No. 2	4	1,436		
.. No. 3	1	1,317		
Restoration of Hariri bridge	—	572	4,445	
<i>Buildings.</i>				
Quarters for staff and Inspection House Lahun		379		
.. .. . Delhanis		377	756	
Grand Total				58,488
				63,689

APPENDIX H.

LIST OF NEW AND REMODELLED BANKS AND CHANNELS EXECUTED UNDER
"SPECIAL WORKS" GIVEN IN APPENDIX F.

NAME OF WORK	Length in kilometres	Quantity of earthwork	Cost.		
			Per work	Total	Grand Total
		C M.	£ E	£ E	£ E.
<i>A.—New Banks (West of Yusufi Project.)</i>					
Completion of Tarrad Tirfa . .	5'000	121,741	1,583	9,385	
" " El Der . .	13'500	324,434	4,623		
Salibah Qayar	4'922	134,622	1,851		
Portion of Tarrad Hariqah . . .	3'468	107,312	1,328		
Total . . .	26'890	688,109			
<i>New Channels.</i>					
Channel at Regulator Salibah Tirfa.	0'467	7,208	94	94	
<i>Remodelled Banks.</i>					
Salibah Bortabat	2'514	126,916	1,733	1,733	
Portion of Tarrad Bortabat . . .	2'791				
Total . . .	5'305				
<i>Remodelled Channels.</i>					
Canal Qamadir	8'056	112,208	1,403	1,403	12,781
Total earthwork, West of Yusufi Project . . .	—	933,541			
Miscellaneous works	—		166	166	
<i>B.—Construction of Bahabshin Basin.</i>					
<i>New Banks.</i>					
Salibah Bahabshin and Bakir . .	6'000	382,635			
Yusufi Tarrad	9'122				
	15'122		—	—	4,783
Grand Total, earthwork . . .		1,316,176			17,564

REVIEWMENT OF BASIN BANKS WITH STONE.

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APPENDIX L.

STATEMENT SHOWING EXPENDITURE INCURRED ON "SHARAKI PREVENTION" WORKS CHARGEABLE TO "SPECIAL SHARAKI" CREDIT
AND ORDINARY BUDGET.

MINISTRY OR CIRCLE	HEAD OF BUDGET	Masonry	Salaries of Establishment and Miscellaneous Expenses	PURCHASE OF MATERIALS			Steamers, Tugs and other boats	Masonry	Salaries of Establishment and Miscellaneous Expenses	Totals
				Stone	Sacks	Other Materials				
		CR.	CR.	CR.	CR.	CR.	CR.	CR.	CR.	CR.
4th Circle	"Special Sharaki" Credit.	1,199	80			97			87	1,463
5th Circle	"			513	200	638				1,351
Ginga Directorate.	"	1,221	61		591	26			31	1,936
Ministry	"		108							108
Total, Special Sharaki Credit. . .		8,120	552	513	791	761			118	11,158
4th Circle	Ordinary, Chapter VI . .	178	7					119		634
Ginga Directorate.	"	351								351
Total, Chap. VI.		832	7					119		988
Grand Total.		9,252	559	513	791	761		119	118	12,146

APPENDIX M.

STATEMENT SHOWING THE AREAS UNDER DIFFERENT CROPS IN THE PROVINCES OF UPPER EGYPT, INCLUDING GOVERNMENT & WAKES LAND & LAND OF THE DAIRA SANIEH & DOMAINS FROM THE COMMENCEMENT OF THE FLOOD OF 1898 TO THAT OF 1899.

Provinces	WINTER CROPS.				SUMMER CROPS.				Total area cultivated and irrigated.	Waste land (Bhar)	Total area of crops	Area of double cropped.	Area of cultivated land.	Total area of crops	Mize, Durra and Sorghum	Barley	Other crops	Total winter crops	Cotton	Sugarcane	Mize and sorghum.	Vegetables	Total Summer crops	K	
	Wheat	Bamboo	Barley	Other crops	Total winter crops	Wheat	Bamboo	Barley																	Other crops
Beni Suef	274,273	5,878	273,667	26,066	2,474,401	30,242	30,242	71,350	61,193	21,011	38,426	298,310	29,106	4,854	5,902	1,219	31,661	223	1,003						
Fayoum	5,39,910	88,031	4,02,479	1,89,293	2,53,186	1,36,915	21,601	69,884	61,139	23,365	88,328	2,46,916	11,296	6,35	54	2,382	14,365	2,681							
Minia	1,67,796	43,952	1,23,824	18,718	474,906	52,469	6,7	91,153	8,636	28,312	95,391	391,255	13,713	37,629	11,468	1,598	66,131	431							
Assiut	1,17,986	11,817	1,05,269	10,151	125,418	25,985	5,988	111,076	122,158	12,472	107,290	482,906	1,254	16,184	26,067	1,679	55,181	1,192							
Giza	277,761	2,986	274,378	14,384	1,99,497	21,151	21,151	102,196	64,692	42,391	109,824	318,415	2,887	29,530	80,507	172	32,867	1,615							
Kafr	1,18,003	11,375	1,06,628	54,429	372,222	48,176	18,176	86,964	18,472	64,412	119,421	318,969	180	16,626	20,000	1,908	38,807	699							
Assuan	88,017	7,765	81,119	5,477	75,672	27,880	27,880	15,401	3,779	17,922	12,158	48,553		69	1,619	1,619	3,319	1,396							
Total	8,639,290	172,184	8,467,107	418,515	2,018,509	313,992	21,664	372,026	1,43,792	912,088	580,451	1,818,457	78,881	78,850	1,07,092	10,898	275,621	8,267							
Column																									

Note. A B+C
C D+E and C F+G+H+K

The above figures are furnished by the Finance Ministry.

APPENDIX N.

STATEMENT SHOWING THE AREAS OF SHARAKI IN THE YEAR 1899 AND THREE PREVIOUS BAD YEARS.

MUDGIYAH	1877	1881	1899			
			WHOLE SHARAKI.			Hall Sharaki
			Uncultivated	Cultivated from wells	Total.	
Awan	62,000	21,036	19,401	3,096	22,437	12,358
Kona	257,883	33,225	79,251	22,965	102,219	33,071
Girga	267,111	15,126	11,619	13,408	58,057	18,443
Ayat	114,866	7,122	23,502	1,275	21,777	10,204
Mina	15,339	26,631	13,979	6	13,985	1,321
Beni Souef	6,740	2,125	8,137	110	8,217	2,102
Totals.	753,992	105,565	188,502	40,800	229,422	80,502

APPENDIX S.

TABLE I.—STATEMENT SHOWING THE QUANTITY OF SUGAR-CANE CRUSHED IN THE DAIRA
SARIEH FACTORIES IN MIDDLE AND UPPER EGYPT IN SEASON 1898-99 AND THE AMOUNT
OF NO. 1 SUGAR PRODUCED.

NAME OF FACTORY	Cane crushed in kantars	Outturn of No. 1 sugar in kantars.
MIDDLE EGYPT.		
Biba	2,020,495	186,591
Magagah	2,733,033	244,403
Matai	1,899,923	173,473
Minia	2,414,057	224,507
Abu Qirqas	1,125,226	110,011
Roda	2,488,126	253,000
Total, Middle Egypt. . .	12,680,860	1,191,985
UPPER EGYPT.		
Dabaiyah	542,302	51,785
Armant	673,637	63,488
Mata'anah.	618,754	62,694
Total, Upper Egypt. . .	1,834,695	177,968
Grand Total. . .	14,515,555	1,369,953

APPENDIX S—*continued*.

TABLE II.—SUGAR-CANE CRUSHED AND SUGAR OBTAINED BY THE DAIRA SANIEN FACTORIES DURING THE LAST 21 YEARS.

Factory season	From crop of	Quantity of cane crushed in kintars	Total sugar produced in kintars	Nature of summer levels preceding factory season	REMARKS.
1880	1879	8,402,833	605,623		The total sugar produced includes the three qualities Nos. 1, 2, and 3.
1881	1880	2,365,642	182,096		
1882	1881	7,336,192	603,225		
1883	1882	1,880,094	422,622	Unfavourable.	
1884	1883	8,445,247	667,451	Favourable.	
1885	1884	9,918,201	851,884	Very favourable.	
1886	1885	11,258,057	973,500	Fair.	
1887	1886	10,986,224	934,376	Favourable.	
1888	1887	10,411,640	961,352	Favourable.	
1889	1888	8,382,837	790,197	Fair.	
1890	1889	7,602,302	695,870	Very favourable.	
1891	1890	11,130,799	1,149,893	Very low.	
1892	1891	12,522,918	1,329,627	Low but early rise.	
1893	1892	12,755,107	1,207,164	Low and late rise.	
1894	1893	14,253,813	1,427,608	Very favourable.	
1895	1894	14,601,832	1,385,345	Favourable.	
1896	1895	15,217,050	1,564,972	Very favourable.	
1897	1896	13,253,433	1,882,979	Very favourable.	
1898	1897	12,369,110	1,176,967	Very favourable.	
1899	1898	11,636,689	1,173,871	Low.	
1900	1899	12,680,860	1,349,983	Very favourable	

* This is calculated from No. 1 Sugar produced by adding one-eighth to allow for Nos. 2 and 3 Sugar, i.e., -

	Kintars.
No. 1 Sugar	1,191,985
Nos. 2 and 3 Sugar	148,998
Total.	<u>1,340,983</u>

NOTE.—The above only includes the Middle Egypt factories, the zone on which is irrigated by the Ibrahimiyah Canal.

APPENDIX S—*continued.*

TABLE III.—SUGAR-CANE CRUSHED AND SUGAR OBTAINED IN SULTAN PASHA'S FACTORY AT DAMARS DURING THE LAST SEVENTEEN YEARS.

Factory Season.	From crop of	Quantity of cane crushed in kantars	Total sugar produced in kantars	REMARKS.
1884	1883	258,855	23,199	The total sugar produced includes the three qualities Nos. 1, 2, and 3.
1885	1884	258,405	24,720	
1886	1885	250,426	23,705	
1887	1886	272,984	23,903	
1888	1887	274,549	23,636	
1889	1888	276,505	24,648	
1890	1889	266,218	23,783	
1891	1890	228,421	31,609	
1892	1891	382,791	36,161	
1893	1892	442,187	37,275	
1894	1893	471,076	40,253	
1895	1894	545,274	47,429	
1896	1895	541,202	51,954	
1897	1896	587,462	59,543	
1898	1897	451,390	40,566	
1899	1898	479,822	48,761	
1900	1899	466,027	46,732 *	

* This is calculated from No. 1 Sugar produced by adding one-ninth to allow for Nos. 2 and 3 Sugar, i.e.,—

	kantars
No. 1 Sugar	42,659
Nos. 2 and 3 Sugar.	4,673
Total.	<u>46,732</u>

NOTE.—The *one-ninth* allowed for Nos. 2 and 3 Sugar is the same proportion as used in former years and has been allowed for for purposes of comparison; the actual proportion is, however, as much as one-sixteenth.

APPENDIX 8—*concluded.*

TABLE IV.—STATEMENT SHOWING THE QUANTITY OF SUGAR-CANE CRUSHED IN THE FACTORIES OF THE "SOCIÉTÉ GÉNÉRALE DES SUCRERIES DE LA HAUTE-ÉGYPTÉ" AND THE QUANTITY OF No. 1 SUGAR PRODUCED DURING THE PAST 3 YEARS.

SEASON	FACTORIES						TOTAL.	
	Naga Hamadi		Shekh-Fadi		Hawamdiya			
	Cane crushed in Kantars	Output of No. 1 Sugar in Kantars	Cane crushed in Kantars	Output of No. 1 Sugar in Kantars	Cane crushed in Kantars	Output of No. 1 Sugar in Kantars	Cane crushed in Kantars	Output of No. 1 Sugar in Kantars
1896-1897	644,438	68,888	1,822,204	191,109	1,333,320	135,554	3,799,962	395,551
1897-1898	1,661,418	108,870	2,782,670	238,574	654,808	56,990	5,098,896	409,434
1898-1899	1,776,825	173,263	3,158,415	304,949	1,315,080	125,790	6,250,320	604,002
1899-1900	1,618,341	168,577	3,169,252	301,191	1,191,278	105,641	5,978,871	575,409

ADMINISTRATION REPORT
OF THE
IRRIGATION DEPARTMENT IN LOWER EGYPT
For 1899

BY
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ADMINISTRATION REPORT OF THE IRRIGATION DEPARTMENT IN LOWER EGYPT FOR 1899.

CHAPTER I.

WINTER, SPRING AND SUMMER IRRIGATION.

It has, of late years, become an established custom to greatly reduce ^{Winter and Spring} all canal discharges during the months of December and January, as, at this time, there is little demand for water: the country is, on the contrary, in need of general drainage after the excessive irrigation of an ordinary flood season, throughout which the canals have carried their maximum discharges with high water levels. As a rule, moreover, the winter rains in the Delta, during December and January, are sufficient for the needs of the winter crop. The opportunity is taken advantage of to execute canal clearances by hand as far as possible. And thus it is evident, that the practice of lowering the canals all over the Delta for the two winter months, has much to recommend it. But, as soon as the canal clearances are over, the time comes, more or less early in February, when the winter crops require a watering. Some few years ago, the demand for water at this time was sufficiently met by maintaining the water level upstream of the Barrage at R.L. 13.50. But, of late years, it has been found necessary to exceed this level by 20 to 30 centimetres. The gradual extension of cultivation is probably the cause of the increased demand at this, as at other seasons. But there is, besides, another cause, which has also been of gradual growth. Cultivators, taught by the experience of the increasing water difficulties of a succession of summers - difficulties due to the extraordinary increase in the areas of cotton crop - have apparently neglected the advantage of early sowings: and cotton sowings have, therefore, been getting earlier year after year, until, in 1899, they began in February. The irrigation of the winter and cotton crops, consequently, now overlap, and a more plentiful supply is thus required in early spring. If it is not given, the winter crops suffer from the deficiency created by the first waterings of the cotton crop.

Ten years ago, after the effect of making the Barrage efficient had been made evident in a great extension of the cotton crop, inequality between the demand and supply of water again arose, as before when

the Barrage was but a name. And especially was this inequality felt in the summer of 1892, when the Barrage was tightly closed and the gates caulked. In that year, although the whole Nile discharge was turned into the canals, there was still found to be an insufficient water supply for the area cultivated. The practice was, therefore, introduced of keeping the upstream level of water at the Barrage low in early spring with the object of checking the tendency to sow a greater area of cotton than could be irrigated during the period of shortest supply in June and July. The usual level adopted, as I have stated before, was R.L. 13.50. But in 1899 it was found that this practice could be followed no longer in consequence of the sudden demand created by the commencement of the cotton sowings before the demand for the irrigation of the winter crops had ceased. The spring supply had, therefore, to be increased by raising the Barrage upstream level to R.L. 14.00, at which level it had to be maintained.

The practice referred to, of limiting the spring water supply, was adopted, in the early days after the Barrage restoration, for reasons which are best given by the following extract from a document that was placed in my hands on assuming charge of the irrigation of Lower Egypt.

" A reference to gauge records of the Barrage will show that it is only towards the end of July that the surface of water is raised to its maximum height.* The uninitiated, which includes almost every one in Egypt except some members of the Irrigation Service, think that the Delta is unnecessarily thus deprived of water and consequently that the cultivated area is smaller than it might be. Were the Barrage to be maintained at its maximum level† throughout the Sefi season until the natural rise of the flood raised the river above this level, the area of Sefi crops sown would undoubtedly be greater than at present, but this larger area could not be matured.

The maximum area requiring irrigation does not occur until late in July before the flood has raised the river above the maximum level to which the Barrage can raise water. The increase in area in the end of July is due to the planting of Dura crop.

Now if the maximum supply is provided early in the season, the maximum area which the Barrage can provide water for will have been reached before Dura sowings commence. And consequently either Dura cannot be planted until the natural rise of the flood increased the quantity of water entering canals, or a certain area of the summer crop must be deprived of water to provide for the new area put under Dura.

To make matters more difficult, the first irrigation of Dura lands requires an abnormal quantity of water; consequently the area of Sefi crop deprived of water would be considerably larger than the area of Dura planted. It is to be in

R.L. 14.00, the level of the top of the gates is meant by maximum level throughout this quotation.

a position to increase the quantity of water entering canals when the area is increased by Dura sowings; that the water surface above the Barrage is not allowed to rise to its maximum earlier in the year. This arrangement undoubtedly limits the area of the Sefi crop but it secures the safety of this limited area."

For some few years past, doubts have been felt as to the soundness or efficiency of the practice adopted of deliberately keeping the canal supplies down in early spring with the object of limiting the areas planted with cotton. In all probability it has no such effect, but has for result, rather, the continuance of the cotton sowings to an unfavourably late date, so as to complete the sowing of the area that it has been decided, irrespective of the supply available, to put under cotton. These late sown crops are, in consequence of the lateness of sowing, so feeble when the hot weather tries them, that they are less able to support a dearth of water than the earlier sown crops are, and the demand for water consequently becomes more pressing than it would have been, had a liberal supply of water been given in the early spring.

It would, however, be advantageous, in some years, if rice sowings could be restricted; but the Irrigation Department has not the power to control the rice cultivation directly, and cultivators must learn to have discretion and adapt their agricultural operations to the conditions of supply as it varies from year to year.

It has thus come to pass that the Irrigation Department is now inclined to the opinion that it is better to place as good a water supply as is available within reach of the cultivators up to the maximum that can be utilized to advantage at any season, leaving it to the cultivator or landowner to limit the areas planted as he may consider to be best for his own interests: for he is in as good a position as anybody to appreciate all the conditions that will affect the crop from sowing to harvest, and the Irrigation Department cannot assume the responsibility of laying down what areas may or may not be planted.

The winter crops in some localities in Northern Gharbiyah suffered in 1899 to a certain extent by a failure of the water supply owing to the causes set forth above, as correct information as to the situation of affairs was not communicated early enough to allow of matters being put right before some crops had suffered. It is hoped that in future this will not recur, as the practice, hitherto followed, of restricting the spring supply will be abandoned, or at least modified, so far as the river discharge admits.

The following quotation from the "Procès-Verbal de l'Assemblée générale ordinaire des actionnaires de la Société Anonyme du Béhéra"

of the 19th April, 1900, conclusively shows the benefit of, in this case, breaking loose from tradition, the new practice of giving an abundant spring supply having been adopted in 1900.

“ En 1898-99 la fourniture d'eau fut tellement réduite qu'elle déterminâ la perte de la moitié des cultures de céréales. Cela fut d'autant plus regrettable que le niveau du Nil avait été plus favorable en été, mais toute la région des Bararis où est situé le domaine social souffrit de la disette d'eau.

“ Par contre l'hiver 1899-900 a été marqué par une irrigation abondante, c'est la meilleure distribution d'eau que l'on ait eu depuis 1895.”

Summit.

The level maintained up-stream of the Barrage during the summer months of 1899 was, on the average, higher than that of any previous year. In the 1st and 3rd Circles, until the end of June, there were no exceptional difficulties of distribution, although the cotton and rice areas were unusually large. But in the 2nd Circle, from the commencement of cotton sowings, there was unceasing difficulty in meeting the demand, in spite of the favourable supply produced by the high levels above the Barrage. There can be only one explanation to account for this: the area of Sefi crops must have increased considerably, which, so far as the cotton crop is concerned, is shewn to be the case by the cotton returns. The North Kasid, Safti and Gafariyah canals were the worst off, but the Sahel and Sherbin canals carried better supplies than they did in 1898.

The Damietta
Branch

The water of the Damietta Branch of the river near the tail became salt early in the year on account of the regulation effected at the Barrage with the object of lowering the water level sufficiently to allow of the construction of the new Weir. But, though the salt water invaded the branch earlier in the year than usual, it did not eventually reach so far south as it did in 1898. For the level downstream of the Weir, which in 1899 was reduced to R.L. 10.00 at an earlier date than ever before, was on the other hand maintained steadily at that level; whereas in 1898 it fell as low as R.L. 9.70 when the Barrage was closed and caulked, and was below R.L. 10.00 from 12th June till 1st August. But in spite of maintaining the downstream level at R.L. 10.00 throughout the summer, some pumps at Ras-el-Khalig and thereabouts were obliged to stop working for a time on account of the river becoming salt. To remedy this, the Inspector of Irrigation of the 1st Circle was instructed to leave the Rayyah Tawfiki Head at the Barrage fully open, and to pass a discharge back into the river through the Mansuriyah Head. This he did willingly at first, when the canal discharge

exceeded his requirements, but, naturally enough, not so willingly later on, when his own difficulties about Damietta and Menzaleh commenced. Nevertheless, the order to keep up the discharge back into the river was insisted on, and considerable assistance was thereby afforded to the 2nd Circle at points where, otherwise, there would have been great difficulties. The pumps of the Behera Irrigation Company at Batra were always able to work, and pumps owned by other landlords as far north as Sawaleh, ten kilometres below Ras-el-Khalig, were able to work steadily with but one or two short interruptions. But notwithstanding the favourable levels maintained above the Barrage, and the provision made for the continuous working of the pumps on the Damietta Branch, it was foreseen that, when the inundation of lands for maize sowings should begin, there would be serious difficulties of distribution in Gharbiyah Province, and at certain points of Dakahliyah Province. A Ministerial Arrêté was, therefore, issued, forbidding the use of water for preparing the ground for the maize sowings during the period between 13th July and 6th August. A similar order will probably be issued every year in which the flood rises late, if the large area of cotton crop and rice is to be insured against the harmful effects of drought in July and early August. But the new Weirs, now under construction, will, when complete, much improve matters, and give a better supply immediately after the rise of the flood makes itself felt at the Barrage; so that it will be possible to allow maize sowings to be made early. Before the Barrage was restored, no cultivator thought of his maize sowings until the flood had risen well; but since the Barrage has done its duty, the sowings have commenced year by year at an earlier date, and the demand to get more work out of the Barrage becomes more pressing.

In many parts of Lower Egypt maize is even, nowadays, sown early in June. But the Barrage cannot augment the river supply, and so, when the Barrage gates are closed and caulked, and the whole river discharge is being forced to flow into the canal, and the supply thus obtained is still insufficient for the cotton crop, maize sowings cannot be allowed to draw on the scanty supply and make it still more insufficient. Consequently, powers must be given to the Irrigation Officers, enabling them to control the date on which water may be taken for the maize crop.

Remarks on the 1st Circle.

The canal discharges of the 1st Circle were so ample, that it was not necessary to impose rotations in the Province of Kaliubiyah.

In Dakahliah rotations were generally in force from 9th June to 11th August, but, at the tail of the Bahr Saghir, they were continued to the 14th September on the account of the bad levels of the early flood. In Sharkiyah rotations were applied from 5th June to 12th August.

Under the system by which all the heads of canals upstream of the Barrage were kept open throughout the summer, the 1st Circle got a great deal more than its fair share of water, and consequently not a fair share of the difficulties of summer distribution. This is to be changed for the future, so that the 1st Circle may have its fair share of both.

On page 177 of "Egyptian Irrigation," Second Edition, Mr. Willcocks gives the distribution of water between the Circles resulting from the practice of leaving the Head Works of the six feeder canals fully open in summer. He shows, what is now fully admitted, that, by such a primitive system of distribution, the 1st Circle has, since 1891, been getting considerably more than its proper share of the summer supply, and the 3rd Circle slightly more than its just share, while the 2nd Circle has been getting less than it should have by the amount given in excess to the 1st and 3rd Circles. On page 281 of the same work, Mr. Willcocks gives as the reason for tolerating such an unjust system, that "the public would have objected to the main canal heads being regulated on." Strange though it seems, this is the only reason I have ever had given me to account for the rule, and also to justify the construction of practically an inefficient second channel along the fort ditch at the Barrage, the object of which was to increase the discharge of the Rayyah Menufiyah. But the public, whose unreason is so much feared, are sometimes wiser than the prophets imagine them to be, and have more than once quietly accepted innovations which they were expected to resist or at least to object to. The common-sense method of distributing the water by regulating on the heads having been decided on (see page 115 of last year's Report) before, and, therefore, independently of any considerations arising from the low flood of 1899, the intention of doing so was officially published in Sir William Garstin's Note on the prospect of the Nile summer supply in 1900, and not a murmur of protest was then or has been since raised by any of the public, who had been expected to object.

Remarks on the 2nd Circle.

Mr. Verschoyle took charge of the 2nd Circle on 15th February, 1899, when Ismail Bey Sirry, the former Inspector, was transferred to a

newly-formed Circle in Upper Egypt. Difficulties of distribution had already begun, and Mr. Verschöyle had to deal with them before he had time to make himself acquainted with his charge; which, however, he lost no time in doing, devoting himself with an unceasing energy to long and exhausting inspections at a time when private interests of a distracting nature might have been held by any one less self-sacrificing to furnish an excuse for being less away from Headquarters.

The dredging of the Rayyah Menufiyah was backward, and in the middle of February there was still one metre depth of silt in the first eleven kilometres, and almost generally, also, to Karinein. An attempt had been made to reduce the silt by the scour which it was hoped the opening of Bir Shams Escape might produce on the fall of the flood, but this measure was quite inefficient.

The sandy canals—the Naggar, Sirsawiyah and Simsiniyah—carried insufficient discharges. This deficiency might have been at least partly met by raising the upstream level above the Barrage, had it not been for the tradition handed down condemning such a proceeding. The decrease of discharge in the main canal, due to backward dredging, would have been compensated for by the same raising of the Barrage upstream water level. The lesson has been learnt and this tradition also has been thrown overboard.

Mr. Verschöyle, in his Report, records the following facts concerning the condition of the water-supply in the 2nd Circle with different Barrage upstream levels, the Rayyah Menufiyah Head being always fully open.

With R.L. 13·85 upstream Barrage from 9th to 20th March, North Gharbiyah got a good supply.

With R.L. 13·50 at the end of March, the tails of long canals got poor supplies. Rotations of a mild form began on the 18th April on Bahr Shirbin, Sahel canal and Rayyah Belkas; and on Bahr Shibin on 1st May.

With R.L. 14·00 upstream Barrage, general rotations were started on 26th May. The first programme allowed 7 days working to 9 days stopping in Menufiyah and S. Gharbiyah, and 4 days working to 6 days stopping in the rice districts of N. Gharbiyah. The effect was excellent till the end of June, and the cultivators of N. Gharbiyah expressed satisfaction with the May and June supplies. But, at the end of June, the Maize sowings brought the usual difficulties. On the 6th July the second programme of rotations succeeded to the first. The second programme allowed 7 days working to 14 days stopping in Menufiyah and S. Gharbiyah, and 7 days working to 7 days stopping in N.

Gharbiyah. But even this programme was found to be not severe enough to secure just distribution, as the demand for water, when Durah sowings commence, cannot be fully met by even the most favourable stammer discharge. There was a failure of supply at the tails of the Kasid and Gafariyah canals. There was not enough water to provide one watering in 21 days to all, so some got one watering in 30 or 40 days. There are too many lifting machines on these canals, which Mr. Verschoye proves plainly by figures.

The object being to obtain an equal distribution of water for all, the moral of the foregoing facts appears to be that too long a period of working is allowed, as compared with the non-working interval. The remedy seems to lie in a shortening of the working period to 6 or even 5 days, and a lengthening of the intervals. Six days working out of a period of 20 days, or 6 out of 27 would be suitable. But if, in consequence of excessive pumping power having been authorised, an allowance of 6 days working does not secure a just distribution, the period of working must be still further reduced to 5 days out of 23, or 5 days out of 29. But these periods cannot be enforced in rice districts, as young rice is said to suffer harm, if the intervals between waterings exceed 5 to 7 days. This consideration introduces awkward complications in any scheme of rotations which has to make allowance for rice.

Rotations in the 2nd Circle continued generally until 20th August, but, on the longer canals, such as the Sahel, Kasid and Gafariyah, they were prolonged till 31st August. Mr. Verschoye notes that the observance of rotation orders is growing, respect for them being probably due to punishment for disobedience following more promptly on the offence than it used to. But the one thing needful to secure a more perfect observance is the making the *owners* of water-course heads and lifting machines responsible for the acts of their agents in charge of the machines. Otherwise they will not hesitate to encourage disobedience of orders, which has for result considerable gain to themselves at the expense of a few days' imprisonment for one of their small employees, or a small fine. The fines for working an engine out of time are so small, compared with the profit to be made by such action that the fines are no deterrent. Especially is this so in the case of large pumps, for, because of the fines remains the same for all sized pumps, while the profit is proportional to the size of the pump. Therefore Mr. Verschoye recommends a scale of fines proportioned to the sizes of pumps.

Mr. Verschoye was not long in finding out that his predecessors in the 2nd Circle had been too liberal with permissions for pumps,

Though possible, it is not practicable to elaborate a just rotation system, unless the power of the pumps and other lifting machines is proportional to the area served. To distribute justly while the power is not so proportioned, some pumps would have to work three days, some four and others five or more; but it would be hopeless to attempt to secure the rigid application of a rotation programme of so complicated a description as would be produced by making these varying allowances. Mr. Verschoye is, therefore, bestowing much attention on the endeavour to reduce the lifting power authorised to what it should be, and has had the satisfaction of effecting a reduction in twenty cases during 1839. The task is up-hill work, as all pressure possible is brought to bear in the opposite direction.

It is further necessary to limit the number of "Pambours" (Archimedean screws) allowed, and to subject them to the same regulations, as regards permits, as Sakyas. Ten to twenty pambours are now sometimes grouped in a row, and, according to Mr. Verschoye, lift as much water as a 6-inch or 8-inch pump.

Remarks on the 3rd Circle.

The water supply of the 3rd Circle was so good that no difficulties were experienced till Durah sowing began, on account of which it became necessary, about the end of June, to apply rotations. But, by the 13th July, so great a proportion of the Durah had been sown, that it was considered of no advantage to prohibit Durah sowings between 13th July and 6th August, as was done in the other two Circles.

Mr. Dupuis, the Inspector of Irrigation of 3rd Circle, mentions Abdul Wahab Zeki Bey, Chief Engineer of Beherah, for his successful conduct of the rotations.

No dam was made at Mohadet El Enin, as the summer levels of the ^{Mevahet} river were good. ^{El Enin dam.}

Crops.

The winter crops were very good, except where the water supply to areas of very limited extent failed.

The rice crop was also a good and unusually large one.

The cotton crop is estimated at the large figure of $6\frac{1}{2}$ million kantars.

The late arrival of the flood water was beneficial to the cotton crop in the Giza Province, as too pickings were obtained before the cotton crops bordering the Iswidi basin were submerged.

The maize crop no doubt suffered generally in yield on account of the lateness of the flood, as well as from its deficiency. Mr. Verschoyle states that this crop in the Menufiyah Province, where it was irrigated by lift, gave an outturn of from 65 to 70 per cent only of a full crop.

Mr. Dupuis notes that some remarkably heavy storms in the first week of October brought in a period of colder weather and, especially in the neighbourhood of Alexandria, did some damage to the standing crop. He also points out that the development of these crops was somewhat affected by the early spell of cold weather, as their growth was backward on account of the lateness of the flood, but that, on the whole, they were good.

The cotton crops for 1879 and for years since 1883 yielded the following quantities of cotton in kantars:

1879	3,186,000	(Highest previous to 1884.)
1884	3,629,000	
1885	2,871,500	
1886	2,872,426	
1887	2,996,485	
1888	2,722,954	
1889	3,237,558	
1890	4,159,405	(Barrage restoration completed.)
1891	4,765,341	
1892	5,220,510	
1893	5,033,235	
1894	4,619,233	
1895	5,256,128	
1896	5,879,479	
1897	6,566,487	
1898	5,583,306	
1899	6,436,000	(about)

According to statistics collected by Chitty Bey, the area planted with cotton in 1899 was 1,153,300 feddans, of which 1,074,500 was in Gizah and Lower Egypt. It follows from these figures that the average yield was over $5\frac{1}{2}$ kantars a feddan.

DUTY OF WATER.

1st Circle.

In a year of good summer discharge, the "duty" of water is always low. In the 1st Circle, which had the proportionately largest share of the water, the duty would naturally be the lowest. For 1899, it is difficult to calculate what the duty in the 1st Circle was, as a large quantity of the discharge was escaped back into the Nile at Mit-Ghamr to drive out the salt water from the lower reaches.

The discharge on the 6th July 1899 was 6,432,776.

The figures are not worth much, but, such as they are, I give them.

Summer crops other than rice	516,237	feddans
Rice	77,813	..
June discharge	18,757,640	cubic metres
Deducting discharge below Abbasa	760,752	..
the balance is	17,996,888	..

The general duty is, then, $\frac{17,996,888 - 77,813 \times 40}{516,237} =$ nearly 29 c.m. a feddan.

Previous years worked out to about 23. The figure used for the discharge includes the quantity escaped into the Nile, as it is not known what it was. Therefore, the duty should work out to something below 29 c.m. a feddan; how much below it is difficult to say.

In the 2nd Circle there was no superfluity of water during the 2nd Circle, summer months. The "duty" can, therefore, be correctly calculated, assuming that our data of areas and discharges are correct.

Using Chitty Bey's figures (which include what Mr. Verschoyle thinks are under-estimates of summer Durah) the following calculation gives the "duty":—

Summer crops other than rice	512,175	feddans
Rice	33,892	..
Mean discharge of R. Menutiyah for April, May, June and first half of July	13,140,000	cubic metres

Duty of water $\frac{13,140,000 - 33,892 \times 40}{512,175} = 23.01$ c.m. per feddan

That is, for crops other than rice	23.01	..
Rice	40.00	..

Mr. Verschoyle argues that Mr. Willecocks' allowance of 22 c.m. per feddan at the head of a canal is insufficient, and he considers it should be nearly 30 c.m. For, with an allowance of 23 c.m. a feddan, some of the crop suffered to a slight extent. Still, with the allowance of 23 c.m., the year proved one of good water supply generally. The general duty of previous years was—

YEAR	Area	General duty
1895.	485,856	24.29
1896.	477,162	23.88
1897.	538,811	24.00
1898.	496,402	19.38

Mr. Verschoyle's experience of the difficulties of water distribution in the 2nd Circle in 1899, when the supply was comparatively good, was such as to make it clear that his predecessor, Ismail Bey Sirri, must, in the previous year, have experienced difficulties in the distribution such as no other Circle has had to meet. Mr. Verschoyle is in a position to compare the conditions of the 2nd and 3rd Circles in this respect, having been in charge of both; and we know that hitherto the 1st Circle has always had, at any date since the opening of the R. Tewfik, considerably more than its just share of the river supply. It is therefore considerably to the credit of Sirri Bey that he managed to carry through the irrigation of the 2nd Circle in the summer of 1898 without a crash. The general "Duty" in 1898 worked out to 19.38 cubic metres a feddan, but, as was pointed out in the Report of that year, some of the "duty" was duty imperfectly performed.

3rd Circle

In the 3rd Circle, the "duty" generally works out lower than in the other Circles, that is, the quantity of water used per feddan is represented by a higher figure; which is the same as saying that the amount of work got out of each cubic metre in the 3rd Circle is less than in the others. But the data for the calculation, both areas of crop and canal discharges, are very unreliable, and I do not think the above conclusion is correct.

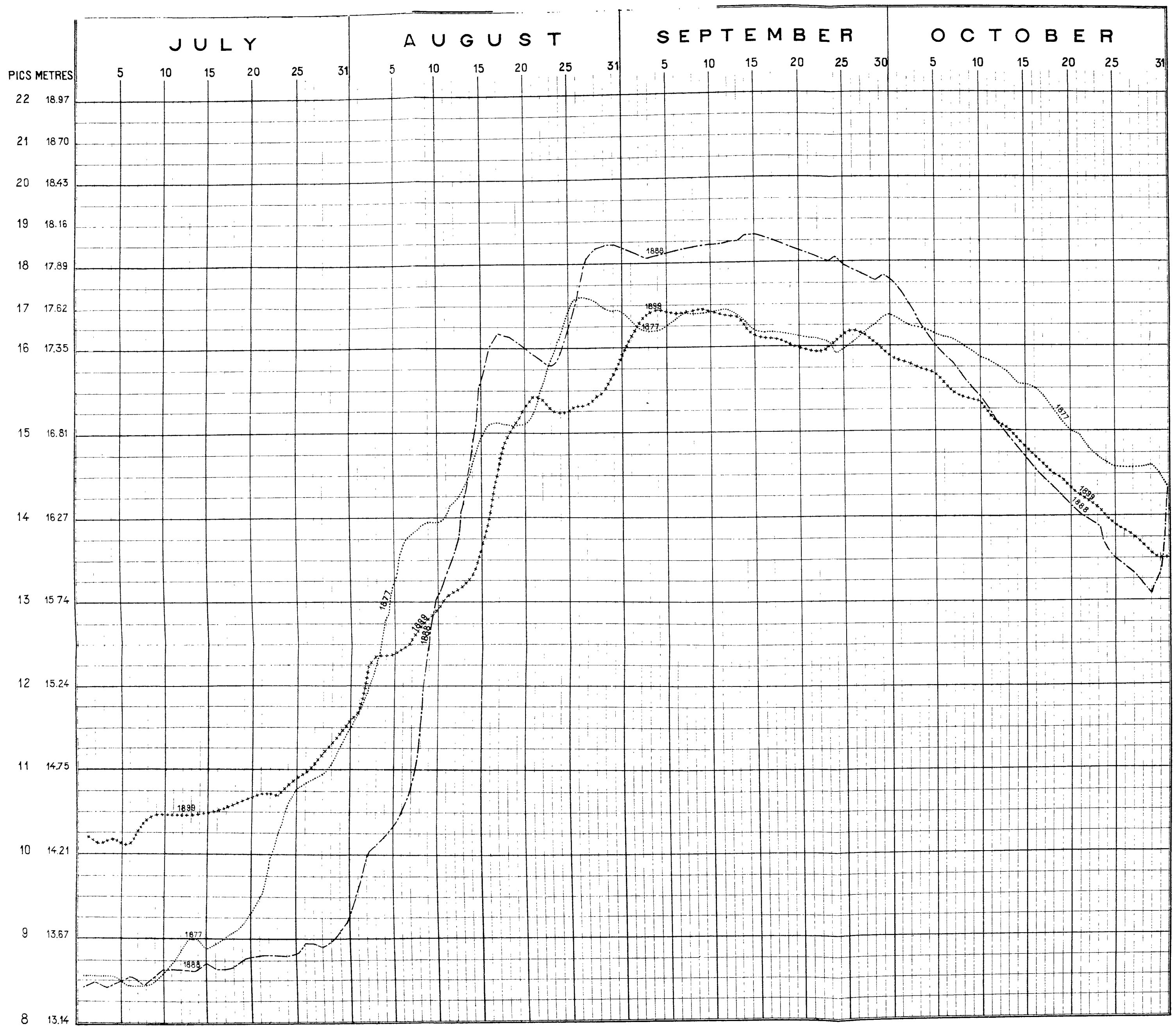
The following is the calculation of 1898:—

Data,—Sefi crops other than rice	229,407 feddans
Sefi rice	17,915 "
Mean discharge, 1st April to 15th July	8,000,558 cubic metres
Duty per feddan of Sefi + $\frac{8,000,558 - 17,915 \times 40}{229,407}$	= 26.75 cum. a feddan.
crop other than rice "	

General.

I conclude from the calculations of the "Duty" of water, made during past years, that Mr. Verschoyle's figure of 30 cubic metres a feddan is *at least* sufficient, and that, even with an allowance of 25 cubic metres a feddan of Sefi crop other than rice, full crops can be raised. The year 1900 will give us a splendid opportunity of determining what can be done with a less allowance.

G A U G E A T R O D A H



CHAPTER II.

FLOOD SEASON.

The flood of 1899, as regards both its maximum and mean levels in ^{Flood levels.} Gizah and at Cairo, was the worst on record (*see* Rodah gauge diagram). Its mean level for the time of flood was 19 centimetres lower than the mean of the 1877 flood, and 48 centimetres lower than the mean of the 1888 flood. The maximum level on the Rodah gauge in 1899 was 9 centimetres below that of 1877, and 48 centimetres below that of 1888. The comparison between the levels of the three years is tabulated below. It is necessary to convert the Rodah gauge readings to Reduced Levels to avoid being led into errors of comparison by the half-pies and half kirats of that gauge for readings between 16 pies and 22 pies.

	1877		1888		1899	
	P	K	P	K	P	K
<i>Aswan Gauge</i> .—Maximum . . .	13	10	14	16	13	22
Mean for south of Sohag, August 11th to October 4th inclusive	12	19½	13	15	12	17
Mean for north of Sohag, August 9th to October 20th inclusive	12	9	12	23	12	1
<i>Rodah Gauge</i> . { Maximum in pies.	P	K	P	K	P	K
	17	3	18	14	16	20
{ Maxim. R.L. metres	R.L.		R.L.		R.L.	
	17.65		18.05		17.57	
August 10th to { Mean in pies. . . .	P	K	P	K	P	K
	15	22	16	22	15	13
October 10th { Mean R.L. metres .	R.L.		R.L.		R.L.	
	17.31		17.60		17.12	

Those who had personal experience of the 1888 flood, will realise how bad a flood the 1899 flood was, seeing that the latter was, throughout, half a metre lower than the earlier flood.

For the sake of comparison between the levels and resulting “Sharaki” ^{Sharaki Areas.} areas of the three years, the following table is given in this place. As.

^{See diagram of Aswan Levels in preceding Report by I.G.L. Upper Egypt.}

in previous years, the figures are those of the uncultivated areas, the figures of 1899 for the same category are entered below:—

LOCALITY	1877	1888	1899	REMARKS
<i>Lower Egypt.</i>	Fodds	Fodds	Fodds	
Gizah	46,209	14,441	28,904	1899 flood was lower than 1877 flood by 49 centimetres, and than 1888 flood by 48 centimetres.
Bahari	19,170	1,700	1,110	
Mouniyah	75,065	1,860	2,026	
Gharbiyah	3,444	Nil	70	
Kalbiyah	25,000	3,263	622	
Sharakiyah	15,495	Nil	Nil	
Dakkiyah	8,095	Nil	193	
Totals.	193,479	21,264	32,925	

The Finance Ministry's figures are given in Appendix K.

No doubt the improvement on 1877 in Lower Egypt proper is due to the Barrage and the canals, which take off from above it, having been since made efficient. But the decrease of Sharaki in Gizah with the worse Nile of 1899 is due to the better management of the water of the basins by both the 3rd and 4th Circles of Irrigation. Most of the Sharaki in Gizah is on the east of the Nile, and, as the 1899 flood was half a metre lower than that of 1888, it is natural that there should be more "Sharaki" there than in the latter year, because the irrigation depends directly on the Nile levels, which cannot be assisted by passing water on from systems on the south, as no connection is possible except at prohibitive cost.

Previous low
floods

The existing record of the Rodah gauge from A.D. 1825 to A.D. 1897 gives only the maximum and minimum readings of the years. The maximum readings show that there were low floods in the years given below:—

A.D.	Maximum reading	19 pies	4 kirats	R.L.
1825.	18	.. 23	18.145
1833.	19	.. 15	18.327
1837.	19	.. 4	18.203
1845.	20	.. 15	18.602
1853. (2 1854)	20	.. 18	18.637
1861.	19	.. 21	18.396

For comparison the maximum for 1877, 1888 and 1899 are given.

A.D.	Maximum reading	17 pies	3 kirats	R.L.
1877.	18	.. 14	17.642
1888.	16	.. 20	17.780
1899.	16	.. 20	17.780

So far, then, as our records tell us, the flood of the year 1899 has been decidedly the worst that Lower Egypt has known during the century.

Djabarti chronicles the following information about low Niles in the 18th century:—

The flood of the year 1705 was so delayed that prayers were offered up. The flood, however, came on the 22nd September, and hymns of praise were sung. Still food became dear and beggars abounded.

In 1782 there was a low flood with its consequences—Sharaki, dearthness of corn and famine.

Again in 1791 there was a low flood and partial famine, and food prices showed a tendency to rise. An attempt was made to check this tendency by nailing to the wall the ears of those merchants who encouraged it. Taxes were remitted because of the drought and famine, and there was no berseem for the winter months.

The low flood of 1791 was followed by a second low one in 1792, which was 2 pies below the normal. The famine therefore continued. Fighting took place in the streets over the corpses of donkeys and horses which were coveted as food; and even babies were sacrificed to the madness of hunger. Caterpillars ate the berseem, while early December was hot and rainless. But about the middle of December there was rain, and consequent rejoicing. But many died, though corn was brought from Turkey. The two years' famine ceased with the next year's flood, which rose to the usual height.

Such is the record of the last two centuries. There are a few in Egypt still, who can remember the flood of 1877, but no record of it, from an irrigation point of view, can be found. We know that there was an area of nearly one million feddans "Sharaki," on which no crops could be raised. This was at a time when the cultivated area of Egypt was much less than it is to day, and, therefore, one million feddans represented a greater fraction of the whole than the same figure would do now.

A good Nile reaches 23 pies, so we may consider a normal Nile as about 22 pies, or R.L. 19'00. The flood of 1899 was nearly 3 large pies (6 small pies) lower than this, and consequently must have been a considerably lower flood than that of 1792, when there was severe famine. The contrast of the situation of the country at the end of 1899 with the situation at the end of 1792 is sufficiently striking. The country, which in 1792 was overshadowed by the gloom of famine, is now enjoying the sunny prospect of a crop of cotton not far short of the record-beating crop of 1897, and a rise in prices; while

the areas that are left unwatered are of so limited extent, and the effects of the drought on the food supply of the country have been so local, that the shortcomings of the flood are scarcely felt except by the Ministry of Finance. The Finances, however, are so little affected by the loss of revenue that the purse strings have been no more than nominally tightened, and that, probably, more for the sake of upholding the traditions of the Department than from any compelling necessity.

After the foregoing general remarks, it will be as well to record any details, reported by the Inspectors of Irrigation, which are at all likely to be of use for reference in future years, when the Nile flood may be similar to that of 1899.

Flood.
1st Circle.

In the 1st Circle, as in the other Circles also, flood rotations were resorted to, not with the object of preventing an excessive amount of water being poured over the country, but, on the contrary, for the purpose of producing full supply levels during alternate periods with discharges which would have been insufficient to produce such levels without rotations. By means of flood rotations, both the Provinces of Dakahliyah and Gharbiyah got the benefit of full supply levels, but Kahiubiyah did not.

The 1st Circle usually has its flood supply supplemented throughout the flood by a direct supply from the river through the Mansuriyah Head, but the flow into the canal lasted, in 1899, from 3rd to 20th September only.

A sum of £E.759 was spent on special work intended to lessen the area of "Sharaki." £E.508 of this was spent on pumping, and the remainder on temporary channels and banks. The pumping had better not have been attempted, as the result of it was unsatisfactory, 278 feddans only having been irrigated and that insufficiently to produce anything but poor crops. The conclusion, that pumping to diminish the area of "Sharaki" is not worth the expense and time bestowed on it, was arrived at in previous years of low floods; and the same conclusion has been reached by Mr. Dupuis in the 3rd Circle in 1899.

Flood.
2nd Circle.

Mr. Verschoyte, the Inspector of the 2nd Circle, was on leave during the greater part of the flood, and Mr. Tottenham acted for him, until he fell ill, when the charge of the Circle was temporarily assumed by Mr. Adamson.

The condition of the water supply in this Circle was this. The flood was about 3 weeks behind time in arriving. The maximum level

reached by the Rayyah Menufiyah at its head was 66 centimetres below what is reckoned full flood supply (R.L. 16'00). The discharge was about two-thirds of the full flood discharge. In addition to this, on account of the lowness of the Nile, the usual supplementary flood feeders gave little or no assistance. Of these feeders the Bir Shams Head drew from the river between 18th August and 14th October, but delivered at a level that was one metre below High Flood Level. The smaller feeders on the Damietta Branch, viz., Um Ahmed, Ibrahim Effendi, Shalabi and Nasrani did not work at all. In consequence of this state of things, the cultivators of Menufiyah and of the south portion of Markaz Santah in the Province of Gharbiyah had to lift water throughout the flood. By means of dividing canals into two sections, and giving each high and low supplies alternate weeks (flood rotations), the rest of Gharbiyah got free flow half the time. To pass the water forward to Northern Gharbiyah, it was necessary to regulate on the Bagariyah, Atf, Bahr Sef, Batamuniyah and Korashiyah canals, and to give alternately 7 days full supply and 7 days two-thirds supply.

A sum of £E.800 was spent, as special expenditure for the prevention of "Sharaki," on temporary banks, channels and cuts, by the operation of which 2,138 feddans were saved from remaining unirrigated (Sharaki).

The 3rd Circle is made up of two Provinces, of which Beherah is ^{flood} under Lower Egypt conditions, and Gizah under Upper Egypt conditions ^{3rd Circle} as regards irrigation.

As in the case of the Rayyah Menufiyah of the 2nd Circle, the Rayyah Beherah never reached full flood, and the river flood feeders at Khatatbeh and Atfeh never worked at all, the river being too low. The Rosetta canal, for the first half of September, was given whatever it could get from the river; but, as that was insufficient, it had afterwards to be fed from the Mahmudiyah. The whole of the Beherah Province was thus dependent on the Rayyah Beherah. It was, therefore, impossible to make the usual "Sadd" at kilometre 12 to assist in the basin irrigation, and the difficulties, described by Mr. Dupuis in his Report hereafter quoted, followed as a natural consequence.

The maximum observed discharge of the Rayyah Beherah was 14,579,136 cubic metres per 24 hours on 16th September, and this gave a deficient supply everywhere.

Sharaki prevention works, costing £E.885, were undertaken. These

consisted in the construction of the following Hoshahs and channels to conduct water to them:—

NAME OF HOSHABS	Approximate areas of Hoshabs.
	Feddans
Dahriyah.	1,525
Shedura	500
Dimosili	400
Mahalletsa	400
Negilah	257
Rahmaniyah.	250
Various	368
Total	3,700

There remained an area of 1,146 feddans unwatered, and admitted to be "Sharaki," on the islands and irregular sandy berms out of reach of the canals.

For ensuring in a low Nile year the irrigation of the Hoshahs above named, it would be well to provide some permanent arrangement.

A small amount of pumping was done by Government with the object of reducing the final "Sharaki" area, but the conclusion, come to in former years as already stated, that it was not worth the expense, was confirmed.

It was unfortunate that the Irrigation Report on the Low Flood of 1888 contained but a bare mention of the operations in the Gizah Province, attention at the time having been concentrated on the Provinces south of Assiout. That this omission may not occur again, I quote below Mr. Dupuis' Report in full. Mr. Dupuis took charge of the 3rd Circle, in January, 1899, so that the 1899 flood was his first flood season. The Chief Engineer of Gizah Province had also come newly to the Province since the preceding flood. Consequently, as the flood was an exceptional one, I thought it necessary to give a good deal of personal attention to Gizah during the flood season. But Mr. Dupuis required little guidance. With remarkable quickness, he soon obtained an intelligent grasp of the conditions of the problems to be dealt with, and it was at once clear that he was to be trusted to work them out himself. The unusual amount of attention bestowed on Gizah during the low flood will probably result in much good to the Province, as the defects in its irrigation system were detected and the remedies were devised. The remedial works are being carried out in 1900.

REPORT ON THE LOW FLOOD OF 1899 IN THE GIZEH PROVINCE.

BY Mr. C. E. DUPUIS, INSPECTOR OF IRRIGATION. 3rd CIRCLE.

"The main canals of the Gizeh Province, namely the Khashab, Gizeh and Zummur, as also the channel leading to the Abu Nimrus Escape, had all been cleared to such levels that they began to flow between the 12th and 15th of August, with gauges corresponding to about 10 pies at Assouan a week before. The approximate actual levels of their beds at head were :—

Khashab	22.75
Gizeh	20.80
Gizeh	20.50
Zummur	16.00
Abu Nimrus	16.50

Note on the Irrigation of the Gizeh basins during the very low flood of 1899.

"In no case was the flow produced in the canals by the flood at any time anything like sufficient, and the supply in the Khashab Canal in particular was miserably inadequate.

"It is believed, in view of the fact that floods such as that of 1899 are fortunately very rare, and also in view of prospective changes and improvements, that it would be sufficient if the following levels were adopted for the heads of the above channels :—

Khashab	22.00
Gizeh	20.00
Gizeh	20.00
Zummur	16.00
Abu Nimrus	16.00

and the fact is noted for record.

"It being quite clear at the time of opening the canals that the flood west of Gizeh was going to be a very low one, an endeavour was made at first to keep the Abu Nimrus Escape open as a supplementary feeder for the West basin system; and, to render this effective, Sakkara Regulator was closed.

"It was, however, soon found that the closing of the Sakkara Regulator was ineffective, the whole of the small discharge available passing through the loosely fitting verticals with a little heading up; while an outcry almost immediately commenced from the cultivators of the important Hoshia tract near Gizeh dependent on the Badeli and Shari

Canals, which draw their supplies through culverts in the Shabramant Saliba, and which canals either did not flow at all, or gave an inappreciable discharge with such levels in Shabramant basin as permitted of any inflow through the Abu Nimrus Escape.

"Shabramant Regulator was therefore closed, and as soon as the inflow at Abu Nimrus ceased, the Escape was closed, and made thoroughly watertight by an earth sadd against the regulator on the basin side.

"The closure at Shabramant regulator proving ineffective for the same reason as given above in the case of Sakkara, it also was soon afterwards closed entirely by an earth sadd against it on the upstream side, which proved a rather troublesome job owing to the difficulty of getting earth.

"At the same time all the regulators above Shabramant were kept fully open, and remained so till the middle of October, the whole available discharge of the Girzah Canal, except the small quantity drawn off by the Gizah Canal (which ran a very small discharge just sufficing for the shadoofs on its line), passing down to and being stored in Shabramant Basin, which again formed a reservoir for the supply of the Baddala and Sherif Canals.

"Shabramant Basin filled very slowly up to a level of 18.96 (over one metre below "ramam rai") by the 10th October, after which date it began to fall, the whole available supply being unable to balance the loss by evaporation and the small draw off of the two canals above named.

"Up to the middle of October, therefore, it had only been found possible to fill one basin about half full, and to afford a small supply to the Gizah Canal, and a fair supply to the Baddala and Sherif Canals for the irrigation of the Nabari crops.

"Even this small supply was only obtained by leaving the Sabah and Komi regulators in the 4th Circle open as long as there was any inflow at Qushesha, which, during the latter part of August and early part of September, afforded the greater part of it.

"The Girza Head was watched to see that no waste occurred by back flow to the river owing to the Komi supply, but, though the inflow became very sluggish at times, the current was never reversed.

"As soon as the inflow at Qushesha ceased, Komi was closed and the West Gizah basins were dependent on the Girzah Head.

"The Agooz Escape at Kafr Amar remained closed throughout the flood, the water of the basin side being always a few centimetres higher than on the river side, until the 4th Circle water was received in quantity, when the head on the basin side became very large.

“Early in October, when it was seen that the Girzah Head supply would soon fail entirely, arrangements were made with the 4th Circle—whose irrigation was considered assured by the large volumes stored in the various basins to the south—to pass on some of the water stored in Riqqa and the lower part of the Qushesha Basin.

“On the 15th October, therefore, Girzah Head was closed (with double planks with earth between), and on the 17th Komi was opened and a considerable volume of water poured into Maarqab Basin. This supply was devoted, in the first instance, to the Gizah Canal and its long chain of high level hoshas on the river edge, the Maarqab regulator being closed.

“It may be noted that the Girzah Head closure leaked a good deal at first, and it would have been better to have saddled the regulator with earth before admitting the Komi water.

“The Maarqab basin was kept at a level of about 24.00 (i.e. 50 below “tamam rai”), this being sufficient for the Gizah Canal; a good deal of water escaped through the loose needle closure of the Maarqab regulator to the lower basins; the lower regulators were all kept similarly closed to keep the water as near the head of the chain as possible.

“The irrigation of the Gizah Canal hoshas continued till the 9th November, by which date it was practically complete down to Badreshayn.

“The 4th Circle beginning to doubt the sufficiency of the supply arriving from the south, Komi was temporarily closed on that date.

“The irrigation of the hoshas gave a good deal of trouble, as, owing to the almost entire absence of culverts in the various dividing banks, the water could only be passed on from one to another by means of cuts, which, once made in the sandy soil found near the river, almost invariably became uncontrollable.

“Also, the very high land levels of some of the hoshas, and particularly of the temporary hoshas made on the river Sahels, necessitated very high water levels throughout the whole of the chain being irrigated; and two or three times, owing to the failure of high bits of temporary bank near the river (under a head of three or four metres), the whole chain drained rapidly away through the open cuts, causing some delay and loss of water.

“The principal temporary hoshas were at Riqqa, approximate area 300 feddans; Kafr Turki near Kafr Amar, 450 feddans; Bemha, 650 feddans; Abu Ragwan and Tarfayah, 1,000 feddans; all of which should undoubtedly be converted into permanent hoshas when the opportunity offers, and funds are available.

"On the 19th November, the 4th Circle having completed its irrigation, Koni regulator was reopened and a very large volume poured into Gizah. The small Maarqab, Thama and Dalishur basins, which had run down a good deal during the 10 days' closure, were rapidly raised to "taman rai" level, and on the 24th November the Salibas in Dalishur, Taluma, Maarqab and Riqqa banks were cut in succession in the order named at a few hours' interval.

"The object of this arrangement was to avoid the danger of excessive levels in any basin owing to the inflow exceeding the outflow. In the Dalishur and Taluma basins particularly the longitudinal banks, protecting the Ayyat Estate of Messrs. Soares' Company, were weak, and an accident here would have done great damage.

"As a matter of fact, except when cut under a big head, the cuts in the banks opened slowly, and practically ceased to widen when their action had diminished the head upon them to a little under half a metre, and the levels in the basins affected fell gradually and fairly uniformly from the time of making the cuts.

"Sakkera basin filled rapidly, but it was found possible to avoid making a cut in the bank by utilizing the old disused regulator near Mitrahenni Village.

"By keeping Shabramant regulator (which had just previously been cleared of earth) open, while the basin rose, it was found possible to avoid making any cuts or other temporary passages in the Shabramant bank. "Taman rai" was reached on the 30th November, and the water stood a little over "taman rai" for five days, the Shabramant regulator being wide open and discharging under a head of about two metres.

"Marshiyah basin reached "taman rai" on the 2nd December, and the bank was then cut in two places, one being near the desert (for the benefit of the high sandy lands on that side of Iswid).

The Nikla
Sadd and Sadd
at Iswid

"Iswid basin reached "taman rai" on the morning of December 6th, and the Nikla Sadd was cut at about midday. This was a particularly interesting operation, as it had never been possible to feed the Rayah Behera from Khetetbah, and there was no sadd at Kilo 12. High levels were necessary in the Rayah Behera to irrigate the northern portion of Iswid and several small tracts of Sharaki land along the Rayah: on the other hand, demand was getting slack in Behera, and it was almost impossible to use the escapes owing to the enormous differences of level between the canals and river. It was decided that the most convenient level in the Rayah at Nikla, after the cutting of the sadd, would be about 16.50 (Richard), the "taman rai" level of Iswid basin

being 17·60, and that endeavours should be made to keep it to this by working the Rayah head as an escape. Um Dinar escape and the regulator at Kilo 21, on which the highest up-stream level considered permissible was 16·00, down-stream level being maintained at 14·00 : this was assisted by working the regulator at Burigat (Kilo 57). The highest permissible level below Burigat regulator was decided to be about R.L. 11·00, if not maintained for too long. The sadd in the Khatatbah flood channel was strengthened, but it was decided that should it be found impossible to control the supply in the Rayah at Burigat within the limits given, this sadd should be cut and the water let off in the river here, rather than risk flooding out Behera : but it was very desirable to avoid doing so, owing to probable damage to the canal channel by the large discharge and high velocity that would be occasioned.

"The Nikla Sadd was effectively cut about 2 p.m. of the 6th December, the level in Iswid basin being 17·64 and in the Rayah Behera below the sadd about 15·20. The cut widened out steadily all the afternoon and night to nearly 100 metres by 8 a.m. of the 7th December. By this time the level of the basin had fallen to 17·34 and the level of the canal had risen to 16·91 : after this the level of the canal began to fall. The current of the Rayah Behera was reversed about 4 p.m. on the 6th December, and the head acted as a very efficient escape, by far the greater part of the first rush of water escaping through it.

"Um Dinar regulator was kept closed to get the highest possible levels for the irrigation of the Um Dinar tract, as it was soon seen that it would be of little or no use for controlling the level of the canal at Nikla, which was the essential matter ; and that it could only be used at great risk to itself.

"The volume passing down the Rayah with a gauge of 16·91 at Nikla was sufficiently checked by holding up to 16·30 at the regulator at Kilo 21 for the level downstream of that regulator not to exceed 14·10, which again was to some extent under control from Burigat.

"These high levels though somewhat in excess of what was originally anticipated or considered safe, were very advantageous for the effective flooding of the large areas of Sharaki lands in the Um Dinar tract and along the Rayah Behera, though they did not last long enough to fully complete the irrigation.

"As soon as the canal at Nikla began to fail, it was known that all danger was over, and regulation was commenced on the head to spin out the high levels as long as possible : these fell slowly, under the influence of the large discharge passing down the Rayah, till the current

at the head reversed itself naturally, and the original conditions were restored.

“The whole operation was most satisfactory and was controlled without difficulty by telegraphic instructions from the Barrage to men stationed at the regulator at Kilo 21, Khatatbah and Burigat.

“The total area reported as sharaki in West Gizah by the Chief Engineer was 4,168 feddans, mostly along the line of the Rayah Behera, but there is no doubt that the Chief Engineers take a very liberal view of what may be considered Sharaki, as in many cases the cultivators took absolutely no steps to help themselves, though the river or a canal was at hand from which, with a little trouble, they could have lifted water.

East Gizah

“In East Gizah the case was very much worse and nearly hopeless from the first.

“The Khashab Canal commenced to run feebly about August 14th, but water did not reach the tail till the beginning of September. The flow throughout was feeble and entirely inadequate. Many of the branch canals hardly ran at all, or only for two or three weeks: no part of the basin system was ever really flooded, the flow barely sufficing for the shadoofs along the line of the main channel. The cultivators took an immense amount of pains to irrigate their lands by any means in their power, and, as in other places, clamoured loudly for the Government to set up and work pumps on their behalf. It was not, however, considered practically possible to do anything except urge the people to try by means of shadoofs on the river's edge and temporary wells to bring their Nabari crops to maturity. This for the most part they succeeded in doing, but though the area of such crops was apparently large and there are a fair number of small pumps on the east bank, the latest reports show about * 33,000 out of the 38,000 feddans in this part of the province remained Sharaki, but the figure seems excessive and is probably inaccurate.

“Nothing but a large pumping station somewhere opposite Wastah can ever secure the greater part of East Gizah from these recurring droughts, but improvements in the Khashab Canal, some of which are already sanctioned and in process of execution, should absolutely secure the smaller half of the tract, north of Ghannaza, from ever again suffering to anything like the same extent.”

In consequence of the very low levels of the flood, watchmen for the Nile banks were unnecessary save at a few exceptional points. In the 1st Circle no watchmen at all were called out. In the 2nd Circle 70 men were out for 49 days on the Rosetta Branch, and 122 men for 25 days on the Damietta Branch. In the 3rd Circle, which is partly a basin Circle, more men were naturally required, as, in spite of the river being low, the basins were filled to the usual levels, though they were kept full for a shorter time than usual. Besides the watchmen required on the basin banks, others were called out to execute emergent work or for watching specially important points subjected to abnormal heads, where a failure, which would have been followed by loss of water, had to be carefully guarded against. Most of the river escapes, and many even of the canal heads, were closed with earthen dams to prevent water escaping back into the river, and these dams, being subjected to severe heads, had to be carefully watched and maintained.

Reduced to the usual 100 days' period of comparison, the numbers of men called out were as follows:—

<i>1st Circle.</i>															1899
Kaliubiyah.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	{ None
Sharkiyah.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dakahliah.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>2nd Circle.</i>															
Menufiyah.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	None
Gharbiyah.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	65
<i>3rd Circle.</i>															
Gizah.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	337
Beherah.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	324
Total.															726

The numbers of flood watchmen turned out in 1877 and 1888 are not recorded, and a comparison of the numbers with any other year is useless.

UPPER NILE GAUGES.

The Victoria Nyanza gauge readings now come regularly and are registered for future use.

During the 1899 flood, the rise and fall of the river was telegraphed from Sennaar on the Blue Nile, from Khartoum, Abu Hamed, Merawi and Kerma, besides from the old established gauges at Wadi Halfa and Aswan.

From the old register of Khartoum gauge readings for the years 1871 to 1883, it appears that the first rise of the real flood at Khartoum takes three weeks to reach Aswan.

From a study of the levels of 1899 it is clear that, with a flood ranging between 12 pies and 14 pies on the Aswan gauge the times taken to travel from Semmar to Cairo and the intermediate gauge stations are as below :

Semmar to Khartoum	2	days
.. Abu Hamad	4	..
.. Merawi	6	..
.. Kerma	8	..
.. Halfa	10	..
.. Aswan	12	..
.. Asyut	15	..
.. Cairo	18	..

Thus, the Khartoum gauge gives us 8 days more warning than we have been accustomed of late years to have, when the frontier was at Wadi Halfa. This extra period would probably decrease to 6 days in a high flood.

No gauges have yet been established on the White Nile above Khartoum; nor at Berber where one is much wanted to give warning of the effect of Atbara floods on the Nile levels. An Irrigation Officer has been sent in 1900 to fix a gauge at Berber.

Lower Egypt
gauge

In Lower Egypt a new masonry gauge has been built on the Damietta Branch at Benha.

CHAPTER III.

DRAINAGE.

Allo-ment and
Expenditure

The Commissioners of the Caisse de la Dette granted from General Reserve a further sum of £E.150,000 for New Drainage Works in 1899. To this was added £E.50,000 from the Public Works Budget.

The following figures give the sums allotted for new drainage works, and the expenditure of 1899 against these allotments. In last year's Report, £E.400,000 is shown as expended on, and not as

the payments were not actually made, this sum is included below in the figure giving the unspent balance of the 1st Circle from 1898.

	1898-99	1899-00	1900-01	Totals
CREDITS				
	£	£	£	£
Unspent balances from 1898.	5,000	1,320	—	9,323
Caisse allotment, 1899.	15,000	52,000	53,000	150,000
Public Works Budget allotment, 1899.	15,000	18,000	17,000	50,000
Totals.	65,000	71,320	70,000	209,323
EXPENDITURE				
	£	£	£	£
Caisse money. (Staff.	2,783	2,218	4,394	9,394
Works	11,137	59,141	43,801	135,379
Public Works Budget—Works	11,219	18,000	16,164	49,179
Totals.	58,139	70,659	65,154	193,952

The unspent balances are mostly due for land purchased but unpaid for at the end of the year.

The accompanying table shows the progress made with the drainage work done, works during the last three years and the resulting expenditure. Further details are given in Appendices B to G.

During 1899 an aggregate length of 136 kilometres of new drains were dug, and 139½ kilometres remodelled, at a total expenditure of £E.193,952. The progress in new drains shown in the 3rd Circle appears small, but this appearance is due to incomplete work having been shown as dug in 1898, which was really not completed till 1899.

The masonry works built as drainage works are detailed in Appendices C, E and G.

The earthwork cubes executed in these drainage works were:—

	1898-99	1899-00	Totals
1st Circle	362,559	1,682,353	2,044,912
2nd "	1,98,000	1,822,172	2,620,172
3rd "	262,830	978,915	1,241,745
Total.	823,389	4,483,440	5,306,829

Two of the principal drainage works in the 1st Circle were the drains ^{drains} dredging to remodelled sections of both the Bahr-el-Bagar and the ^{1st Circle} Bahr-Tawil. These two bahrs are the two main drains of a vast extent of country, and it is most important, for the efficiency of the drains tailing into them, that their channels shall be kept to full section and free from weeds. To discourage the growth of weeds the drains are now being given extra depth instead of width. The end reach is carried well into the lake and terminated in a splaying tail of increasing width and diminishing depth from the point where it ceases to be contained between lateral banks.

The Arin drain was extensively remodelled, remarkably good progress having been made by the Contractors who undertook the earthwork.

A useful rectification of the alignment of the Bashmur drain was made: the Nizam drain was widened and progress made with the Balamun, Bilbeis, Mansuriyah and Bahr Salt branch drains.

The Gohena railway bridge on the Bahr-el-Bagar was provided with a removable bry, and so altered that its waterway was increased at the same time that it was adapted to the passage of dredgers. A bucket dredger actually passed it during the year, after finishing its work above the bridge.

In the 2nd Circle good progress has been made with the drainage of ^{drains} all systems except the Sharkawiyah, which is backward. In this system, ^{2nd Circle} the Beltin syphon had been completed previously to 1899, and these necessary canal head sluices were built during 1899, so that arrangements are now sufficiently advanced for the drainage works proper to be taken in hand.

In the Bahr Shubin system the remodelling of the main east and west drains, known as the Muhit and the Demillash, is complete in the former and well advanced in the latter drain. In the Bahr Mallah system and the smaller Fuah system the drains are also nearly complete.

The Nashart system is the most extensive in the 2nd Circle, including a drainage area of 339,000 feddans. During 1898 and 1899 much has been done towards carrying out this drainage project. The Um Yusuf drain, the most important branch of the system, has been completed. The irrigation works, which were necessary before the rest of the project could be executed, are practically complete. They comprise such important works as the Kafr Rabi Lock and Regulator, the Kalline Regulator, and the Sidi Salem and Zem Locks and Regulators.

The expenditure on this drainage system during the past two years is given in the following figures :—

Year 1898	£E.
1899	22,583
	<u>11,243</u>
Total	£E.33,826

Desmes
and Canal

The most important drainage works in the 3rd Circle were the completion of the Lalku, Khairi and Khandak Gharbi drains (so far as it is intended to complete them for the present), the commencement of the remodelling of the Unum and the Shereshrah drains, and the completion of the enlargement of the Mex pumping station.

The Lalku system of drains is so far completed that more attention will now be given to the Marcotis drainage system, and the funds available will be chiefly devoted to its improvement and extension. The Lalku system was undertaken first, to give time for the completion of the enlargement of Mex pumping station on which the Marcotis system depends. This enlargement, on which £E.16,536 was expended in 1899, is now so far complete that all the pumps are in place and in working order. There remains still the chimney to be built, the water supply arrangements to be perfected and the inlet channel to be put in order and bridged.

A commencement was made in 1899 in the Marcotis system by excavating 20 kilometres of new channel at the tail of the Unum drain, remodelling the Desmes drain, and also seven kilometres of the Shereshrah drain, with visible effect upon the country served by them.

PUMPING STATIONS FOR DRAINAGE.

Kassassine

The Kassassine pumps worked to much the same extent as in past years, and the year's expenditure was £E.1,224, £E.799 of which was charged to the Public Works Budget and the remaining £E.425 to the Wadi Tamut Estate. In consequence of the new arrangement made for the management of the lands depending on this pumping station for drainage, the expenditure on pumping will not in future be protracted. As this station is placed under the same management as the estate, further reference to it will be made in the chapter which deals with the Wadi Tamut.

MEX PUMPING STATION, AND LAKIS MARCOTIS AND EDEI

Mex.

The particulars of the Mex pumping station and the effect of the pumping and rainfall respectively on the level of the Lake Marcotis

are fully dealt with in the following quotation from Mr. Dupuis' Report. His remarks about Lake Edku and his opinion about the question of controlling the flow of the sea out to the inlet at the place known as Mandieh, by a permanent regulator, are also given in his own words.

"The existing pumps had an unprecedentedly heavy task thrown upon them in dealing with the water of Lake Marcous during the winter of 1898-1899, which rose to the very high level of 25' in December, 1898, and remained at about that level during the 6 months.

"That this high level was primarily due to the heavy winter rainfall is clearly shown by the exceptional rise during November and December when the rainfall was heaviest, and by the fact that none of the drains leading into the lake were altered or improved during the preceding year, while the Khairi drain intercepted and diverted to Lake Edku a considerable portion of the water that used to find its way into Lake Marcous; while, during the current winter with greatly improved drains and a smaller rainfall, in spite of less work at Mex, the lake has never reached within 30 centimetres of last year's levels.

"The following comparative table of maximum and minimum levels of the lake is interesting :

SEASONS	Report	Maximum	Date	Minimum	Date
1894-1895	6.04	-2.43	March 17th.	-3.28	August 24th.
1895-1896	10.45	-2.17	March 17th.	-3.15	August 22nd.
1896-1897	8.53	-2.93	January 7th.	-2.92	Sept. 11th.
1897-1898	13.94	-2.17	Jan. 23rd, March 13th.	-3.29	August 25th.
1898-1899	11.88	-1.95	February 18th.	-3.26	Sept. 1st.
1899-1900	8.28	-2.29	January 27th.	?	?

"The quantity of water pumped out Mex during the season 1898-1899 amounted to no less than 284,896,74 cubic metres at a cost of £18,378.

"This was the first year that the pumps were run wholly by Government agency, and the economy of the working agent is clearly shown in the following table, and would have been still more marked but for the great rise in the price of coal.

"The pumps began to work on 11th November, 1898, and stopped working finally on 17th March, 1899.

“ Total quantity of water pumped at Mex and cost of pumping during the last few years :—

SEASON	Quantity of water pumped cubic metres.	Cost.	Rate per million cubic metres.
		L.E.	L.E.
1895-1896	175,078,166	7,588	43·004
1896-1897	216,994,810	8,068	37·000
1897-1898	227,129,530	8,675	38·000
1898-1899	284,896,064	8,378	30·000

Lake Edku.

“ The rise and fall of Lake Edku were in no way remarkable during the year.

“ It may, however, be worthy of note in connection with the proposal to construct a regulator at the Lake outlet at Maadiyeh, that the question was investigated with some care during the year, with the result that it is believed that such a regulator would be difficult to make and would do little or no good, and might do much harm.

“ There is no doubt that during the marked rise of the sea level that takes place during winter storms (due largely, it is believed, to low barometric pressure at such times) combined with the low level of the lake at its north-western end, owing to the high wind prevailing, a strong inflow into the lake does occasionally take place, but the opposite conditions not infrequently occur, causing an equally strong outflow, and it is believed that the net result of these natural causes is to produce an abnormally wide and deep channel for the ordinary outward discharge, which tends to reduce to a minimum the mean relative elevation of the lake level necessary to produce that discharge; while the rise of the level of the lake produced by the occasional temporary inflow must be very small owing to the large area over which it is spread.

“ The sand-bar naturally formed by the action of the sea-waves at the mouth of outlet wants watching, as it forms very rapidly when the current slackens and, once formed, requires to be cut artificially. It closes the outlet naturally every year as soon as the outflow ceases, and with a little attention forms a very serviceable natural regulator for the large annual fluctuations of the lake level.

“The following table gives the maximum and minimum lake level gauges during the last few years:—

SEASON	Maximum level.	Date	Minimum level during succeeding summer	Date
1895-1896	0·80	September 22nd.	0·04	August 4th.
1896-1897	0·86	September 27th.	0·02	July 14th.
1897-1898	0·52	December 26th.	—0·20	July 17th.
1898-1899	0·80	December 4th.	—0·06	July 9th.
1899-1900	0·72	December 29th.		

“No observations were made during the year on the discharge of the lake outlet, but in a view of the extent to which such observations are vitiated by the effect of tidal action it is not believed that they are of any real value.”

CHAPTER IV.

THE BARRAGE.

Regulation.

The Nile discharge of the summer of 1899 never fell so low as to necessitate the complete closing of the Barrage gates. The level below the Damietta Branch Barrage was ponded up to R.L. 10·46 by the Weir under construction 500 metres below it; but the river level immediately downstream of the Weir was kept steadily at R.L. 10·00 by allowing such a discharge to pass the Barrage as would produce that level. In consequence of the pool between Barrage and Weir being held up by the latter to R.L. 10·46, 3·54 metres was the maximum head to which the Damietta Barrage was subjected when the upstream level was raised to R.L. 14·00. As this Barrage had, since the previous summer, been through a course of grouting (as described in the 1898 Report), no anxiety was felt about its safety under the action of this head.

From 19th February to 24th April the water level upstream of the Barrage was made to vary between R.L. 13·50 and R.L. 13·85. On

25th April, on account of difficulties felt in the north of Gharbiyah Province, the upstream level was raised to R.L. 14'00, and this level was maintained till 11th June. But on the 12th June the downstream level of the Rosetta Branch fell below R.L. 10'00, and, as the order was that a head of 4 metres on the Barrage was not to be exceeded, the upstream level had to be reduced to conform with the order. Consequently, between 12th and 29th June, the upstream level varied between R.L. 13'98 and R.L. 13'91, as it was not thought worth while to take temporary measures for ponding up the downstream level on this branch until the first rise, which was known to be on its way, should arrive. The lowest downstream level of R.L. 9'92 was recorded on the 21st June, which was, therefore, the date of minimum discharge of the river at Cairo. After this there was a slight rise, but so slight and hesitating that it was not till the 31st July that an upstream level of R.L. 14'30 was reached at the Barrage.

During August and until the 9th September the river still rose, though unsatisfactorily, until its wretched maximum of R.L. 15'61 above the Barrage was reached. With this up-stream level neither Barrage was fully opened. The downstream level on both branches was R.L. 15'33, and there was a head of 28 centimetres on the Rosetta Branch and 16 centimetres on the Damietta. After the 10th September, as the river fell, the gates of the Barrage were partially closed again to improve the upstream levels.

This is the first time that the Barrage has been regulated on throughout the flood. It used to be a rule that the Director of the Barrage should not go on leave till the Barrage was fully opened. Had the rule been insisted on, the Director would be still waiting for his release.

The Barrage was regulated on so as to maintain the following relations between the up and downstream levels:—

Upstream	Downstream	Head	
14'00	10'00	4'00	
14'25	10'50	3'75	
14'50	10'80	3'50	
14'75	11'40	3'25	
14'40	11'40	3'00	
15'00	15'50	1'50	For every centimetre of rise upstream downstream to be raised 3/4
15'50	15'00	5'50	
15'40	15'30	5'30	
15'67	15'51	5'16	

For every centimetre of rise upstream downstream to be raised 3/4 until Barrage is fully opened

If the levels of the last line of the list had been reached, the Barrage would have, probably, been fully open, but the rise stopped when the upstream level was R.L. 15.61 and the downstream R.L. 15.33.

As the river fell, the same figures as for the rise were reproduced in the reverse order.

Partly on account of the unfinished state of the work on the Damietta Branch Weir, the Damietta Barrage was not opened to let an increased discharge pass till the 1st August. But had there been no such reason for delay, the river at Damietta would have felt the rise but a few days earlier at the most, as the increase of the river up to the end of July was not much more than sufficient to raise the downstream level on the Rosetta Branch sufficiently to allow of the upstream level being raised above R.L. 14.00. An earlier opening of the Damietta Barrage would have reduced the upstream level and, therefore, the discharge entering the canals at a time when an increase was urgently wanted.

EXPENDITURE ON THE BARRAGE.

There were no special works of consolidation or repairs undertaken in 1899 on the Barrage itself, as the present condition of the work appears to be satisfactory. The total expenditure, including the salaries of the permanent staff charged to I. 1.3) was as below :

	£L.
Establishment charges	1,395
Works (IX.5)	10,803
Garden fund	16
	<hr/>
Total	£L.15,647

A sum of £L.167, shown in the accounts as expenditure against IX.5, is included above in establishment charges to which it properly belongs.

In 1898 the Barrage expenditure was:

	£L.
Establishment charges	1,173
Works (IX.5)	15,260
Garden fund	123
	<hr/>
Total	£L.20,999

The decrease in the expenditure of 1899 is due to the fact that no special work was executed on the Barrage itself, and also to a less sum

having been spent on River Training. The expenditure under the head of ordinary maintenance, stores, labour and gardens has increased. The detail of the expenditure on works is as follows :—

	£E.
Ordinary maintenance of regulators, buildings, ironwork, roads, lock-channels and revetments	2,848
Stores	2,035
Labour	2,299
River training	1,856
New landing stage	250
Gardens	1,876
Meteorological instruments	88
Total	£E.11,252

River
training

All the river spurs were thoroughly repaired, the stone bar above Koratayn channel lengthened, and the tree bar across it added to. Little change in the river channels took place during the low flood of 1899, but that little was in the right direction.

New landing
stage

A new landing stage, costing £E.250, was constructed to Mr. Brooke's design, chiefly from surplus material left over after the restoration of the Barrage under Colonel Western.

Gardens.

The increased expenditure on gardens is due to the cost of lifting water being charged against "Gardens" instead of, as formerly, against "Workshops"; and also to the necessity of setting up a new pulso-metre and cistern, and laying down new mains, before any further development of the gardens was possible. In addition to the sum of £E.1,130 charged against the Budget, a further sum of £E.446 was expended from the Garden Fund resulting from the sales of fruit, rent of land, etc.

Meteorological
instruments

Two sets of meteorological instruments have been paid for, having been purchased by Captain Lyons, one to be established at the Barrage and the other at Mex, where officers of the Irrigation Service are available to record the daily observations.

WEIRS BELOW THE BARRAGE.

During the experimental season's work in 1898, as described in last year's Report, a length of 80 metres of the Damietta Branch Weir was constructed and the west flight of steps built. Much useful experience was also gained, and the method of construction for the rest of the



PLATE I.—VIEW OF THE DAVITYA BRANCH WEIR IN PROGRESS, TAKEN FROM THE EAST END ON 18TH APRIL, 1899.
THIS VIEW SHOWS THE SIDE WALL OF THE LOCK, IN THE FOREGROUND, STILL BEING FORMED ON THE LEFT. THE CORE WALL (TO THE LEFT) AND THE FOOTING WALL (TO THE RIGHT) ARE ALSO BEING FORMED. THE CONCRETE BARRIS IN THE IMMEDIATE FOREGROUND HAVE BEEN COLLECTED FOR THE OPERATION OF PUTTING IN THE LOCK FLOOT BY GRANTING AS SOON AS THE SIDE WALLS ARE COMPLETED.

work decided on. The original design and manner of constructing the boxes, in which the blocks to form the Weir core were to be made by grouting, were elaborated from Sir Benjamin Baker's roughly sketched suggestions by Mr. Allan Joseph, assisted by Mr. Stent. The framework and sides of the box and the contrivances for putting it together were improved upon under the teachings of experience during the course of the work, but the final form and arrangements were all modifications of the original idea, the credit for which is due to the two officers named. Mr. Mason designed another form of box and apparatus for handling it, which showed considerable ingenuity. With his boxes he successfully put in the footing and cross walls.

Having gained experience by the first season's work, the programme for 1899 could be confidently laid down, and adequate preparations made accordingly. During the flood season, from August to November, Mr. Stent and Mr. Mason were busy making their preparations for the coming season and were very efficiently assisted by Mr. Tarasconi, the Chief of the Barrage Workshops. To the preparations then made and to the successful start given to the work in 1898, when Mr. Allan Joseph was in charge, was mainly due the success of the following season's work. The collection of materials, and purchase and preparation of the necessary plant were part of the first season's work that made it possible to carry out the next season's programme.

The programme laid down for 1899 was the completion of the Damietta Branch Weir up to R.L. 11'50, with the exception of two lengths of 100 metres each, which were to be carried up to R.L. 11'00 only: the lock was to be built as far as possible, but at least all work below R.L. 12'00 was to be completed: the revetment at the west end was to be prolonged, and the banks in connection with the west staircase were to be completed, and the contiguous Nile bank remodelled. This programme was carried out almost entirely, the lock having been completed to R.L. 13'30. The only exception to completeness was that the clay filling upstream of the core wall, along a length of about 60 metres of the first year's work, could not be arranged for, and this had to be left for completion in 1900.

In 1899, as in 1898, the flood was late in arriving, and it was possible to continue work up to the last day of July. Consequently, a fortnight more than we had any right to expect was obtained, without which the season's work would not have been so satisfactorily completed in either year. In 1899 the stone filling between the two Weir walls and upstream of the core wall was not commenced till the 27th June, and over 50,000 cubic metres had to be put in place.

The quantities of work executed and amounts expended in the two seasons work are given in the following table:—

Darsietta Weir and Lock.

	1898	1899	Total
	Cubic met.	Cubic met.	Cubic met.
Dredging	38,010	173,808	211,818
Earthwork filling	51,139	6,061	57,200
Grouted masonry	2,939	17,491	20,430
Skipped cover to	400	1,250	1,650
Masonry—Rubble in bottom and line	641	4,144	4,785
Masonry—Rubble in sand and cement	—	2,476	2,476
Brick masonry (in lock)	—	1,300	1,300
Ashtar masonry	51	351	405
Dry rubble pitching	6,892	56,773	63,665
Heavy talus blocks	800	12,130	12,930
Clay on sides of core	1,000	15,785	16,785
Remodelling Nile bank	—	13,970	13,970
Expenditure	£L 81,856	£E. 159,873	£E. 241,729

The expenditure covers also the purchase of most of the plant and materials required for the Rosetta Branch Weir.

Mr. Brooke, as Director of the Barrage, had the direction of this work. Mr. Stent was in general charge of the arrangements for the work of the Weir, excepting that portion that was entrusted to Mr. Mason. Mr. Stent exercised a constant and careful supervision over the work on the main core wall and the lock, on which Mr. West gave invaluable assistance. Mr. Stent showed great resource in the contrivances adopted for getting in the lock foundations in the novel manner described further on in this Report. He had the satisfaction of conducting an eminently successful operation. Mr. West is the most experienced and successful of all the Weir staff in the conduct of grouting operations. He unquestionably secured the record in making grouted blocks by completing two successively in two days each. Each block was 9 metres long, so that in four days he built, in 6·40 metres of water, 18 metres of core wall, 6·15 metres high and 3 metres wide. The two blocks together cubed 349 cubic metres and took 1,108 barrels of cement; which gives a rate of 3·18 barrels to the cubic metre, or 34 per cent of cement.



PLATE II.—VIEW OF THE DAMIETTA BRANCH WEIR IN PROGRESS, TAKEN FROM THE WEST END ON 28TH JANUARY, 1899.

The core loading and cross walls have been finished to above water level (with the exception of a short length of the 1898 core wall) and the clay deposited on either side of the core wall. The rubble pitching has begun in No. 2 compartment from the west. The near bay is the one formed in 1898, over which the leakage and spring water from between the Weir and the barrage is being carried past the Weir.

Mr. Grieve and Mr. Boyes stuck to their work well, and contributed considerably to the success of the grouting operations by going down themselves in the divers' dresses and examining the work done by the divers, who were consequently the more careful as to the manner in which they performed their duties.

Mr. Mason's share in the work was very considerable and satisfactory: he built the footing wall and cross walls: he put the heavy blocks into position at an unexpectedly rapid rate without the aid of a locomotive: he built several temporary bridges over the water channel and arranged the transport, putting into place and surface building of the rubble pitching. It was due to his energy during the last month's work that we succeeded in getting through with our programme.

Mr. Tarasconi kept the locomotives and trucks going, and gave invaluable assistance in all matters in which the workshops were called upon to contribute their share towards the work.

All the staff cheerfully took their turn of night work whenever it was necessary, and, I am afraid, several of them suffered in health in consequence of the contrast between the conditions of day and night work in the river bed during the summer months.

Diary of Season 1899.

The following is a connected diary of the season's work.

The second season's work began by dredging operations, which were started on the 20th November, 1898. The rate of progress was not satisfactory, and it was not until the 29th January 1899 that the first raft could be got into position to put together the first box. Filling the first box with material began on the 1st February, with the water level at R. L. 11.50.

The dredging of the lock space progressed badly, and work on it could not be begun until the 21st February. A second raft was got to work on the 22nd February, and a third and fourth raft on the 14th March. The four rafts had been ready to begin work in January, but the slow progress of the dredging caused the delay, which was serious enough, but a good margin had been allowed in the calculations, when deciding on the arrangements to be made, and it was still thought that the season's programme would be completed easily.

Work on the footing wall was commenced on the 21st March.

On the 10th April the discharge of the Damietta Branch was diverted from the deep channel and made to flow over the portion of the Weir

built in 1898, so that the next season's work could be joined up with that built in the former season. The grouting of the two side walls of the lock were finished on the 19th April, when work stopped till the 22nd for the Coorban Bāīram holidays.

The lock floor material and grouting pipes and platforms across the lock were not in place and ready for grouting to commence for a month after the side walls were finished. This cannot be considered rapid work, and more of the margin of time allowed was thus lost. The grouting of the lock floor commenced at 7 a.m. on the 19th May and was completed on the 22nd at midnight. The end walls were next filled and grouted, and, on the 26th May, the lock space was pumped out. On the 2nd June the foundations of the walls to form the ends of the revetted slopes were finished by grouting, and the next day the last bit of grouting work on the Damietta Weir was finished in the closing block of the Weir footing wall.

A great deal too much loose rubble, concrete-metal and pebbles had been thrown in to form the lock floor, so that the removal of the ungrouted excess and the way it encumbered the work caused further delay, which might have been avoided.

The operation of grouting walls having been completed on the 3rd June, clay filling commenced, and took more time to complete than could be spared for it. During the month of June, also, the work on the lock became slack; but at the end of June a change was made, and a very good month's work was got through in July. Clay filling was completed or nearly so on the 27th June, and rubble pitching began. The necessity of waiting for one description of work to be completed before another was commenced was perhaps to a great extent unavoidable on account of the time it took to complete the lock foundations and for other reasons. However that may be, the result was that, on the completion of the clay filling on the 27th June, a simple calculation demonstrated that, not only had the margin of time disappeared, but, with work going on as it was then, the programme could not possibly be completed before the flood would stop the work, even allowing that it could be continued to the end of July, which the news from the Upper Nile, fortunately so far as this work was concerned, showed to be likely. Over 50,000 cubic metres of rubble had to be put in position, and the locomotives and their trucks, working day and night, could not do more than 30,000 to 40,000 cubic metres at the outside in the time remaining. It was, therefore, necessary to make other arrangements for getting in the remainder of the work to be done. Orders were accordingly given to two contractors to deliver between them 13,000

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PLATE III. VIEW OF THE DANIELLA BRANCH WEIR FROM THE EAST, FROM THE SAME POINT AS PLATE I,
TAKEN ON 14TH JULY, 1899.

THIS view shows the progress made with the rubble-pitching. Camels were employed to fill the first compartment on the East, adjacent to the lock.

cubic metres of stone at two different points whence it could be transported by camels and carts to the Weirs and put in place, without interfering with the three trains, which were doing the maximum work possible under a well-organised system directed by Mr. Mason, depositing on an average 1,300 cubic metres a day. To get the stone to the Weir from one of the new points of delivery on the Rayyah Tewfiki, two strings of camels had to cross the lock which was under construction, so that, to avoid delaying the masonry of the lock, two temporary bridges across it had to be made.

The help of the camels, which filled the east compartment of the Weir between the lock and the first cross wall, and the carts and camels which brought stone for the slope upstream of the core wall from a point above the Barrage on the west, saved the situation, and, in spite of all the delays enumerated, the programme was completed, but without an hour to spare. On the morning of the 1st August, the Damietta Barrage was partially opened and the Weir was all under water by noon.

Method of Construction.

A general description of the manner of building the Weir was given in last year's Report, which it may be useful to supplement by further detail.

The season's work commences, of course, by getting the plant prepared and the materials collected. As soon as the river has fallen sufficiently towards the end of November, dredging commences, and the bed of the river is taken out to the cross section of the weir bed shewn on the drawing No. 1 opposite page 140 of the Report for 1898. As soon as the dredging is sufficiently advanced for work on the Weirs to commence, the water level is reduced to R.L. 11.50 by regulation on the Barrage. A raft, formed of two large barges kept by timbers at a convenient distance apart for forming the boxes between them, is moved into position, and a four-sided box 9 metres long, 3 metres broad and 8 metres high is put together. This box is made as follows (see diagram). A double tier of horizontal frames is suspended between the barges, the lower frame being suspended by chains from the upper frame and being 4 metres below it. The upper frame is suspended at water level. The barges having been moored in correct position, the box frames are then got into accurate alignment and fixed there. The sides of the box are then formed by ungrooved sheet piles, 30 centimetres wide fastened together in sets of five so

as to form a width of 1.50 metres, and weighted at the bottom end so that they may tend to float vertically in water and be easily handled. The bottom end is shod with a piece of projecting sheet iron, so as to make a good joint with the river bed and prevent the escape of the grout. When the sides of the box have been formed, the whole interior surface of the box is lined with sacking, overlapping at the angles and at the bed junction. The sacking is kept in place and protected from being torn by the rubble, when filling is going on, by nailing thin planks about a metre apart against it from water surface to bed. Divers are constantly at work during these operations. Four perforated pipes are then fixed along the axis of the box at equal distances, and the box is filled with rubble and concrete metal (20 per cent) and pebbles (15 per cent) thrown in from above, up to slightly above water level. Unperforated pipes are then inserted into two alternate perforated pipes, reaching nearly to the bottom of the box: on the top end of these pipes are screwed funnels, and over the funnels are fixed coarse wire sieves to catch the pieces of paper of the cement barrels and other foreign substances that may get mixed with the cement grout. In the other two pipes floats, which sink in water and float in cement grout, are suspended, so that the rise of the grout may be watched. The object of grouting into an unperforated inner pipe is to deliver an unbroken column of grout at first at the bottom of the box, and afterwards just below the surface of the sea of ascending grout. If grout were poured directly into the perforated pipe, each bucket of grout would have to fall through water. The inner pipes are changed over from time to time to the alternate perforated pipes, and gradually shortened as the grout rises higher. To lessen the danger of leaks at the bottom of the box from the pressure of too great a head of liquid grout, (which being twice as heavy as water exercises a pressure in water equal to the pressure exerted by a head of water in air.) it was generally arranged that a depth of one metre should be grouted overnight, and be left till the next morning to set, so as to form a solid bottom to the box on which the rest of the grout would be supported.

The grouting was continued next day until the grout rose slightly above the water surface: the scum was cleared away, and stones put by hand into all the spaces where there was an excess of cement grout. The block was then left for the night, and next morning was found to have set hard enough for the box, in which it was formed, to be loosened and moved forward.

The second and subsequent boxes were made as three-sided boxes,

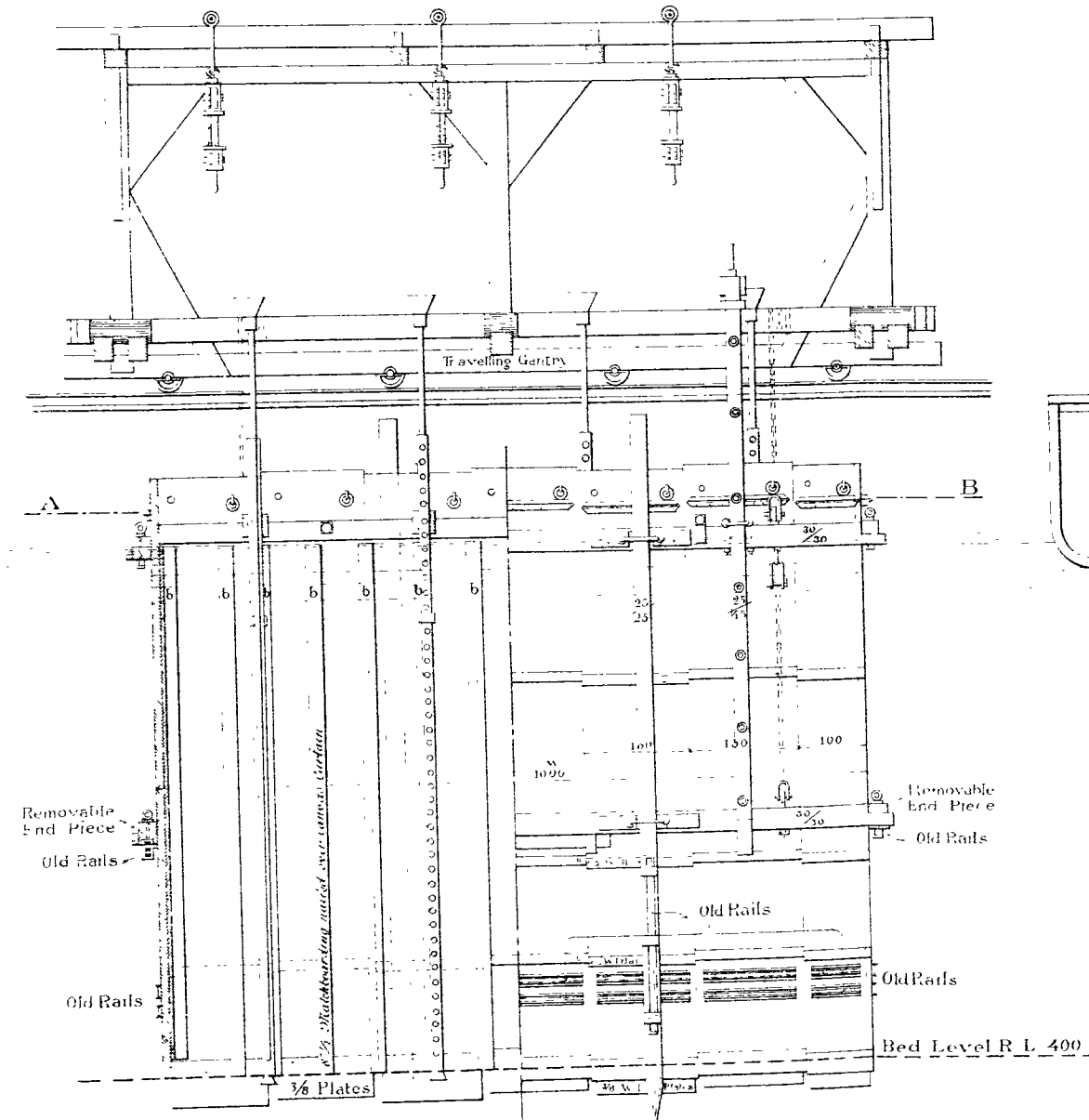
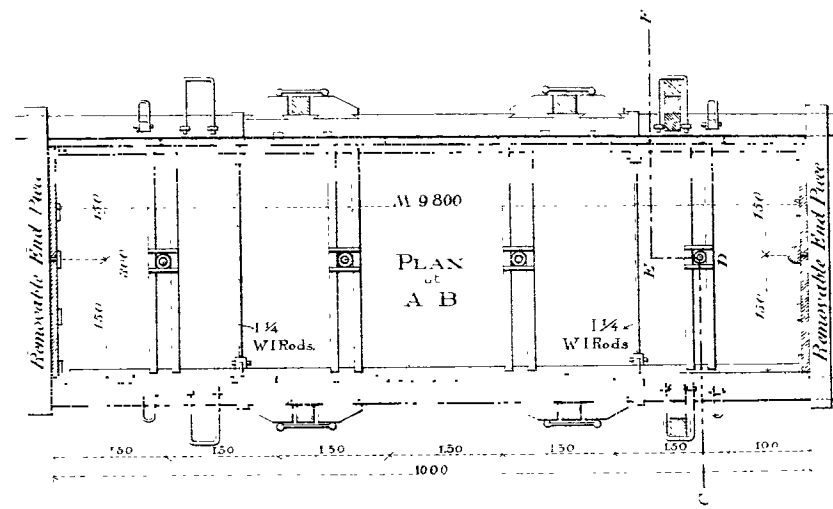
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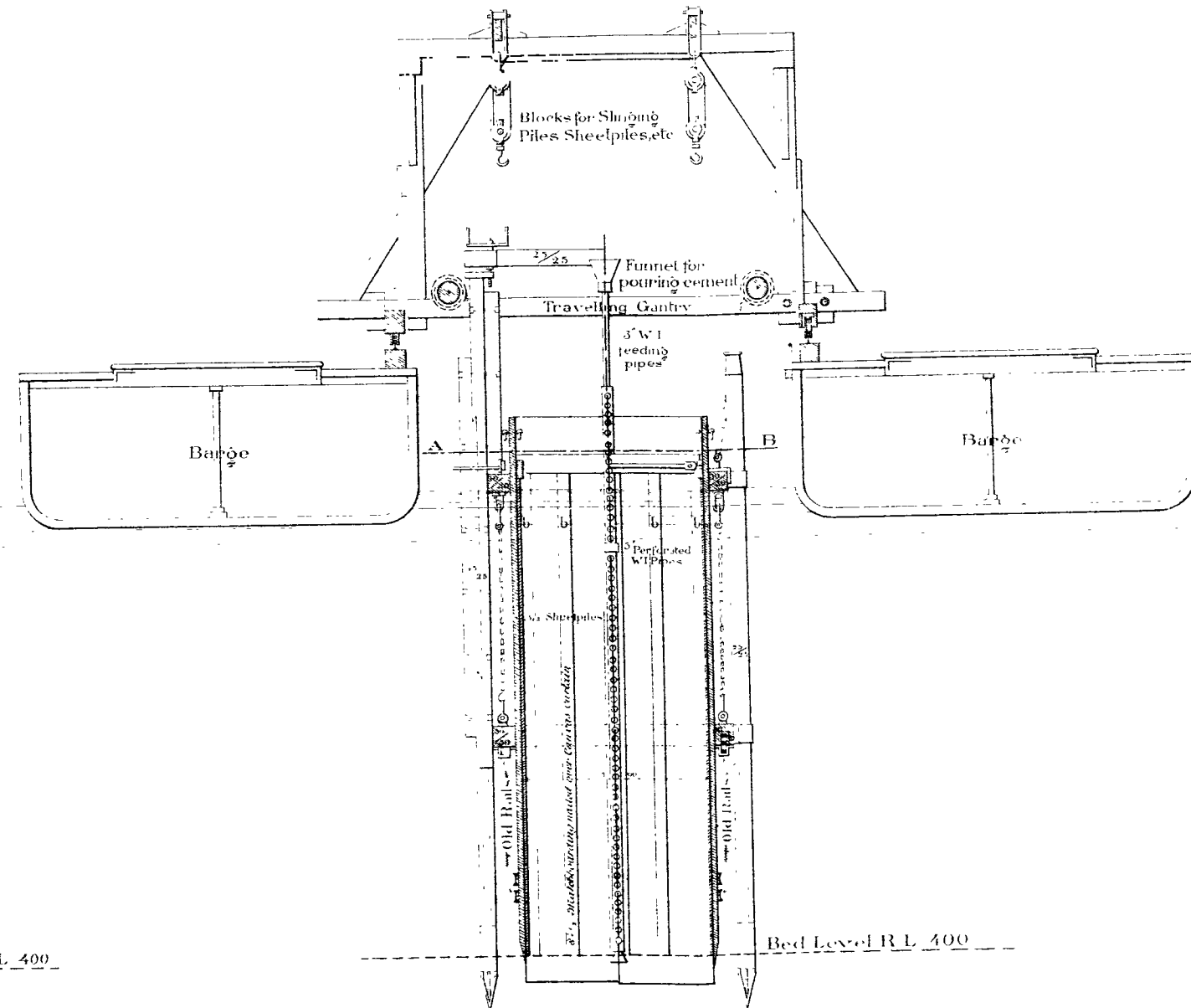
The second and subsequent boxes were made as three-sided boxes,

BOX and FLOATING GANTRY USED ON NEW WEIRS FOR GROUTING SUB-AQUEOUS WALLS

Scale = $\frac{1}{100}$
1 2 3 4 5 Metres



HALF SECTION HALF ELEVATION

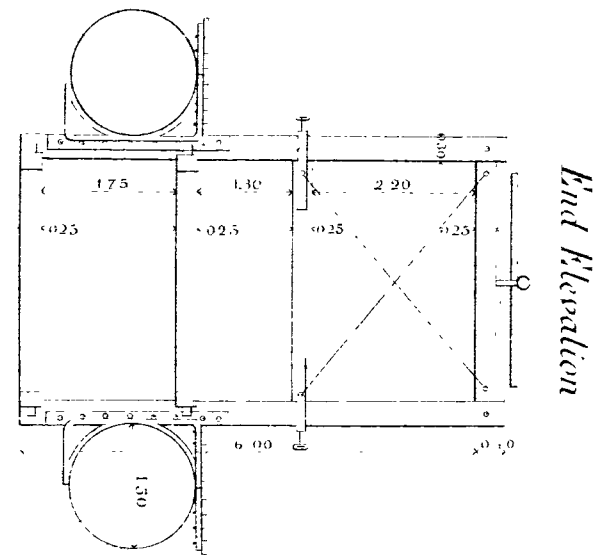
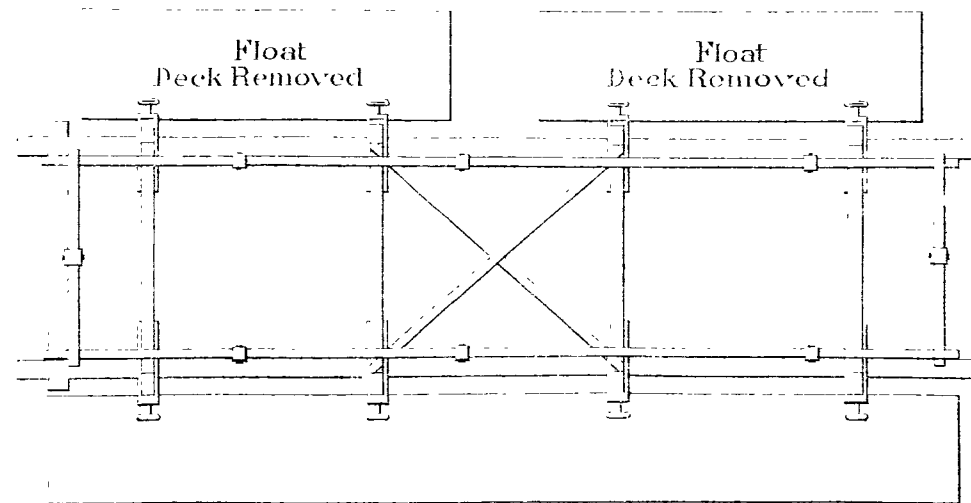


SECTION C.D.E.F

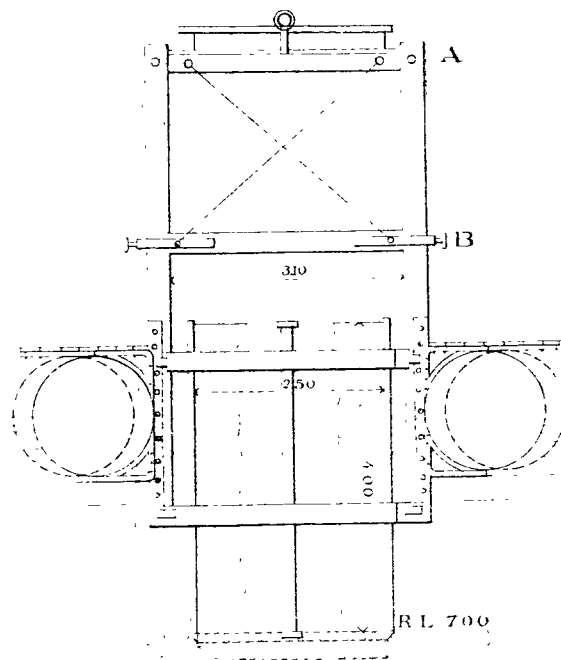
APPARATUS FOR FORMING BOX FOR BUILDING FOOTING WALL

Scale $\frac{1}{100}$

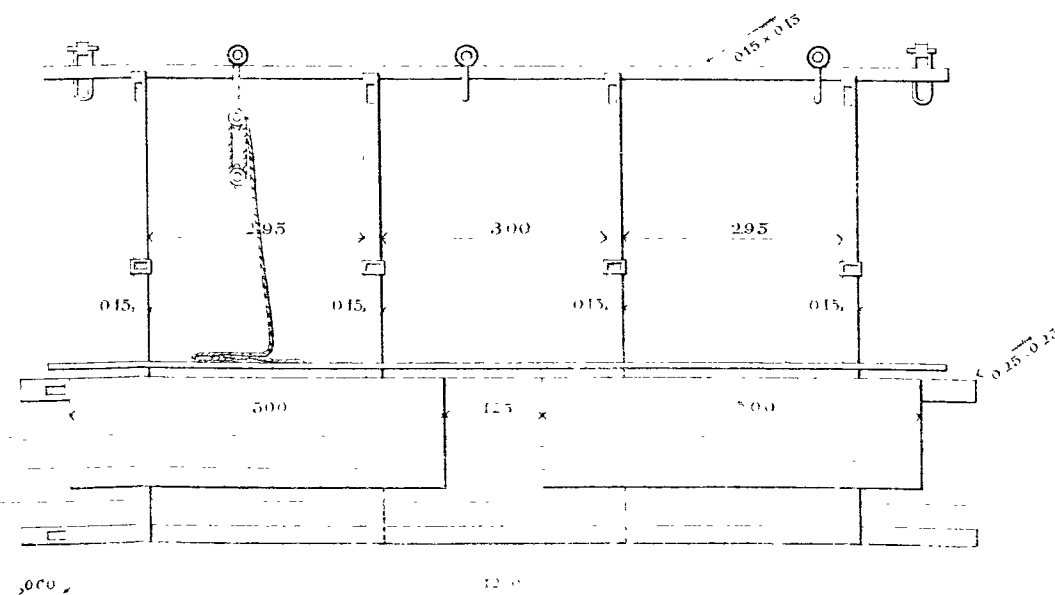
Plan



End Elevation showing cross section of box formed and released



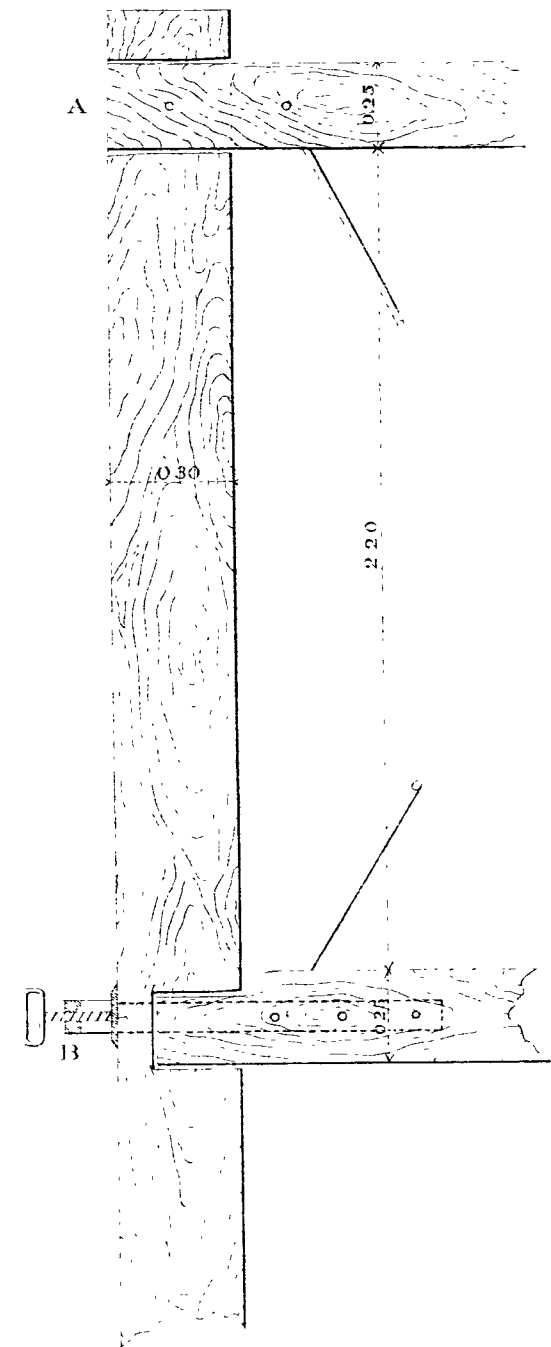
Side Elevation



Sectional Elevation

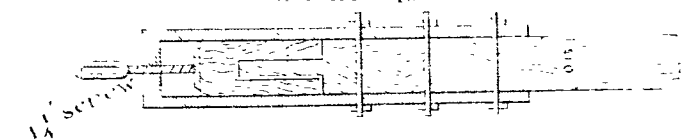
A. B.

Scale $\frac{1}{10}$



Sectional Plan of B.

Scale $\frac{1}{10}$

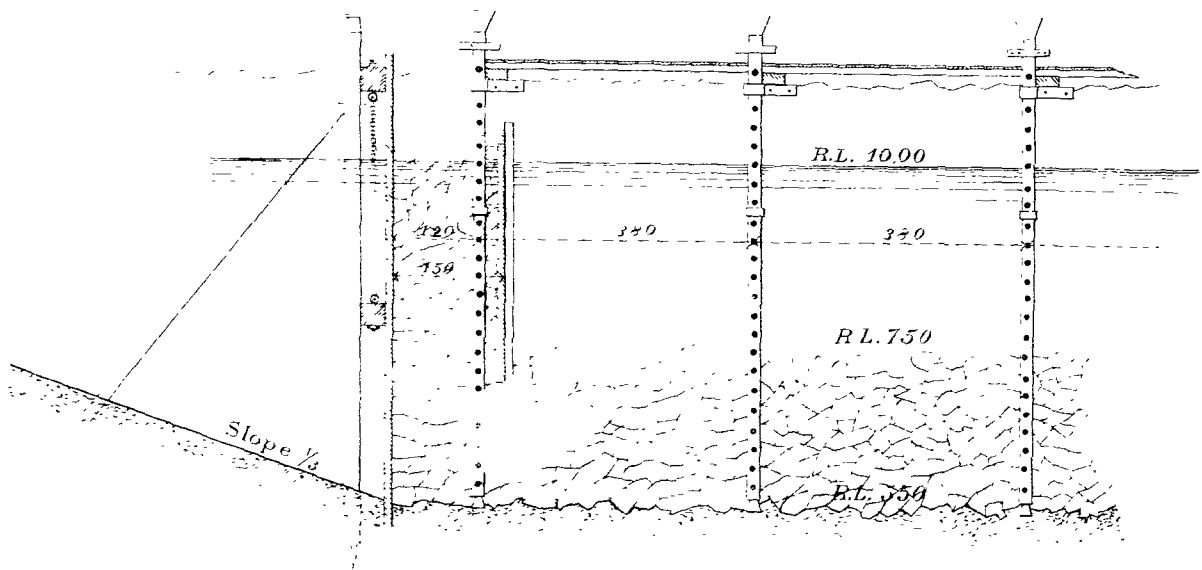


CROSS AND PART LONGITUDINAL SECTION OF THE WEIR LOCK
OF THE
DAMIETTA BRANCH

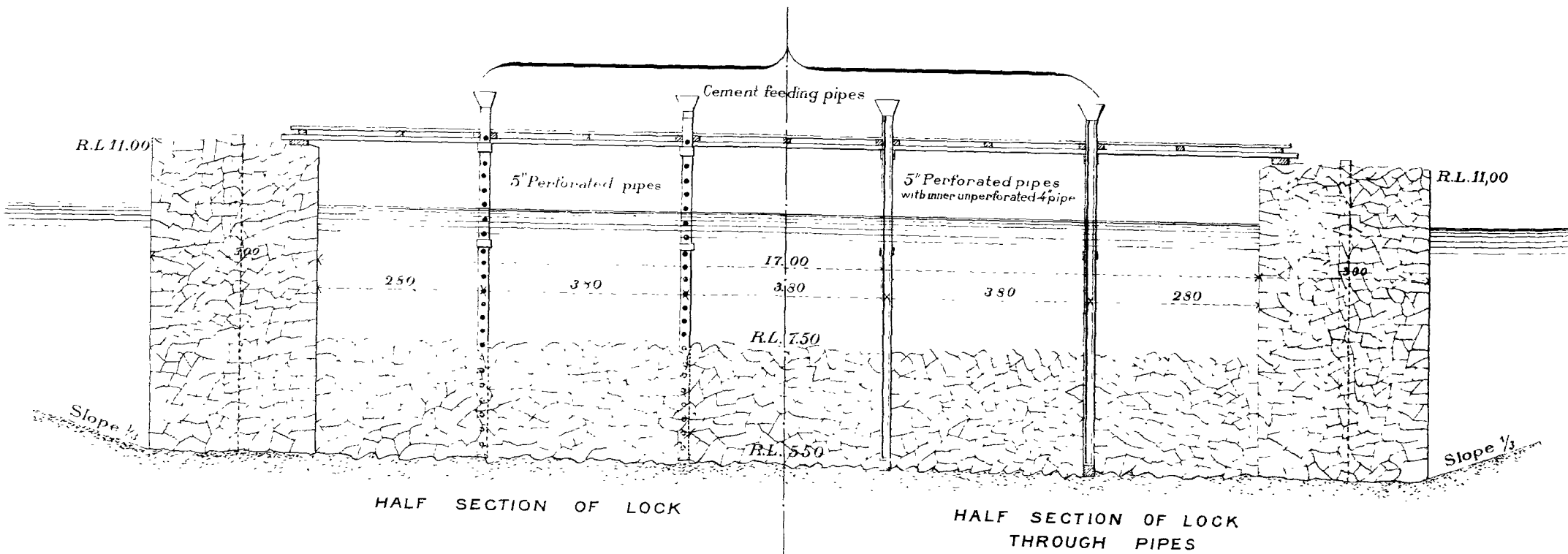
to show method of getting in foundations
by Cement — grouting

Scale = $\frac{1}{100}$

LONGITUDINAL SECTION
of one end of the LOCK



CROSS SECTION



the last grouted block forming the fourth side, and being clasped by the side beams of the horizontal frames.

A box and its contained block took from three to four days to make, so that, when the four rafts were at work, the average rate of progress was about 10 metres of core-wall or lock-wall a day. Each block contained from 160 to 170 cubic metres of masonry, and was about 9 metres long by 3 broad and 6 high. At the commencement of the season, the blocks were $7\frac{1}{2}$ metres high, decreasing to 6 metres as the water fell.

The cement grout was mixed by hand in iron troughs by ordinary labourers, gangs of Soudanese Blacks being the best mixers. The consistency of the grout varied from thin to thick, the proportion of water depending on the judgment of the mixers. When first using cement grout to strengthen the Barrage foundations, attempts were made to measure the amount of water, but, in consequence of the peculiar nature of the workmen, the measuring was never properly done; and so it was decided to give up the measures and to control the consistency by observing what was brought in buckets to the grouting pipes. Experiments and experience on the work itself seemed to show that, whether thin or thick, the cement grout set satisfactorily and gave the desired result. Possibly the grout, in consequence of its high specific gravity, gets rid of excess of water when it is in a liquid mass and free to do so. Whatever the explanation, it appeared to be unnecessary to be particular about the proportion of water in the grout when used as in the work under description. But it is necessary to be careful to get a cement that will behave satisfactorily under such severe conditions, and this appears from experiments made with many kinds of cement not to be a difficulty.

The diagram of the apparatus, designed by Mr. Mason, and used in 1900 to form the footing wall of the Rosetta Branch Weir, is given also here to complete the group of diagrams.

The lock foundations were got in entirely by grouting, and, as I believe this system has never been applied to such an operation before, it may be useful to describe the manner of doing it (see diagram). Lock foundation.

The foundation bed was dredged out all over to R.L. 5.50, and the water level reduced by regulation on the Barrage to R.L. 10.00. Two parallel walls, bounding all the lock area on either side, were then formed by the same system as that adopted for the formation of the core-wall. The rectangle of which these walls formed the sides $\simeq 100$

metres long by 17 metres broad between the walls) was then closed at the two ends by sheet piles supported by horizontal beams, which were kept in place by piles driven a short distance into the bed of the river and tied at their tops to the side walls already formed. A staging was then constructed across the enclosed space from side wall to side wall, and the perforated pipes fixed in place about $3\frac{1}{4}$ metres apart all over the area. Two metres depth of rubble, concrete metal and pebbles were then thrown in to form the floor foundation. At about one metre distance from the two ends a second interior cross wall of sheet piling was arranged with the lower ends below the level to which the two-metre layer of rubble would come. All the sheet piling was lined on the inside with sacking to prevent the escape of cement grout between the joints, in the same way as in the boxes.

When the two-metre depth of floor material had been deposited, grouting commenced at one end of the lock and continued day and night till the other end was reached. The grouting commenced on the 19th May at 7 a.m., and finished at midnight of the 22nd. The end walls were then filled and grouted. On the 26th April the enclosed space was pumped out in half a day, and the grouting was found to have formed a perfect floor without the sign of a spring in it. The rest of the lock floor and walls was built in the dry in the ordinary manner.

As the grouting was executed under water and was not continued, as in the boxes, until the grout rose about water surface, arrangements had to be made for ascertaining to what level the grout had risen. A simple arrangement revealed this. The grout was poured into alternate pipes, and in the pipes, where grouting was not going on, a float was suspended so weighted that it would sink in water and float in cement grout, the specific gravity of the latter being double that of the former. The string to which the float was attached was passed over a pulley wheel, and the other end of the string weighted sufficiently to keep the string taut.

The cost of pumping out the lock space was £E.23, and this was the only expenditure in pumping incurred in getting in the foundations of the weir and lock.

By this method a perfectly sound floor is obtained, as no troublesome springs create defects by forming a way under or through the masonry while under construction. When the cement has set, the springs are all effectually shut out and helpless, and the enclosed water can be pumped out without any fear or difficulty.

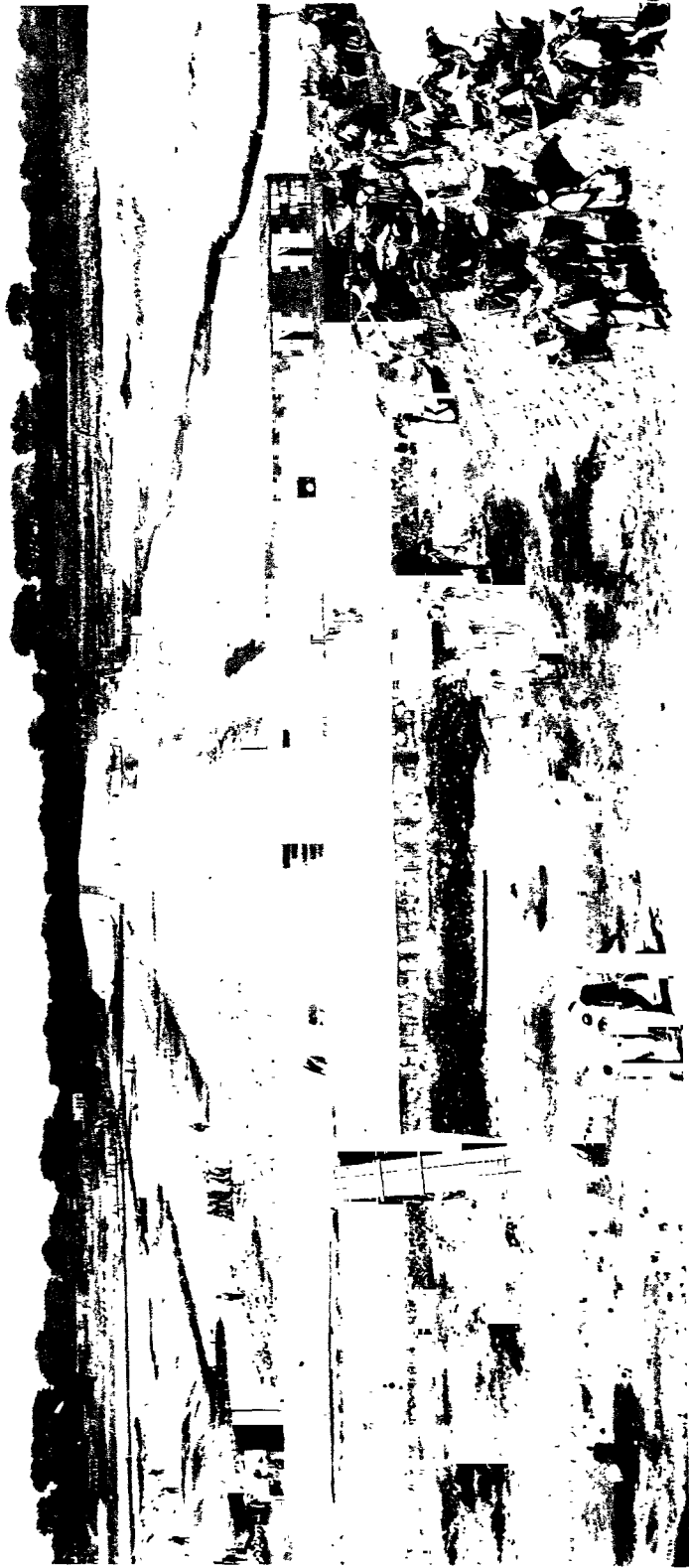


PLATE IV.—VIEW OF THE DARDETTA BRANCH WEIR, TAKEN ON 1ST AUGUST, 1899, FROM THE EAST.
 This view is taken from the same point as plates I and III, immediately before the Barrage gates were lifted and the whole put under water. A certain amount of water was still passing the Barrage, when the photograph was taken, sufficient to produce a flow over the Weir crests built to R.L. 11.00 but not high enough to cover the lengths at R.L. 11.50. The downstream level had already risen sufficiently to almost submerge the low blocks downstream of the footing wall.

Quantities and Cost of Work.

The total cube of sub-aqueous wall and lock foundation grouted in the two seasons was 20,256 cubic metres and the number of barrels of cement used in the work 69,464. This gives 3.43 barrels to the cubic metre, or* 36.76 per cent of cement.

These figures include the first five boxes made in 1898, which leaked freely and took from 7.70 to 4.33 barrels to the cubic metre. We have, therefore, succeeded in reducing the cement below the figure expected, which was 40 per cent. This has been done by exercising great care that the boxes shall not leak, and in adding 20 per cent of concrete metal and 15 per cent of desert pebbles to fill the interstices of the rubble with which the box is filled. Care in filling the box evenly possibly also affects the result.

The cost per cubic metre was originally estimated at 240 piastres. The work has actually cost this throughout, for the rise in price of cement from P.T. 50 to P.T. 60 a barrel has been balanced by the economy effected in the proportion of cement used, which resulted from greater skill in working gained by experience.

Third Season of Work on the Weirs.

As soon as the second season's work was over, most of the Staff went on leave, and Mr. Mason, who was left in charge of the Barrage, began to get things ready for the third and heaviest season's work. The programme for 1900 is the complete construction of the Rosetta Branch Weir to one metre below finished crest level, and of the lock to at least the level of the top of the first cast-iron hollow quoin. As the weir on the Rosetta Branch will be 500 metres long, whereas the Damietta Weir is only 418 metres, of which part was built in 1898, the programme for 1900 is a bigger undertaking than the season's work of 1899. Consequently it was of first importance that perfect preparations should be made, and Mr. Mason deserves great credit for the way in which he made them. The plant was transferred from the Damietta to the Rosetta Branch, and six large rafts for the deep walls and two for the footing and cross-walls were fitted up with all the necessary plant for making the boxes: new lines of railway were laid to both ends of the Weir to be built, stock was taken of all material

*It is assumed that 9½ barrels of cement go to the cubic metre.

after it had been got into order on the stacking ground and in store, the balance of plant and materials required was ordered, and the earthwork excavation by hand down to water level was executed at both ends of the Weir preparatory to starting the dredging operations.

Dredging began on the 1st November, 1899, and was sufficiently advanced for the first box to be begun on the 19th December, and the first block at the east end of the core-wall to be completed before Christmas. Before the end of the year a second block had been added at the east end, and a second raft had completed its first block on the lock wall on the west side of the river. The dredging had progressed satisfactorily, and there was every promise of a good start being made.

Work on the lock of the Damietta Branch Weir was resumed in December and by the end of the year a thousand cubic metres of brickwork had been added to the previous season's work.

CHAPTER V.

WORKS.

The expenditure as it appears, in the accounts, is given as usual in Appendix A. But a detailed analysis of the abstracts of Ledgers shows that some Establishment charges have been included under Works, Protective Work under Maintenance and Repairs, and that, in other respects, the expenditure is not quite accurately shown by the abstract of accounts. I have, therefore, made out the accompanying statement, separating all Establishment charges from Works, and grouping the actual expenditure correctly under the heads given in the statement. "Establishment charges" includes salaries of permanent and temporary staff, wages of bridge gaffers, rotation patrols, survey parties, and all kinds of staff other than actual labourers, excepting only in the case of "Pumping Stations," the figures for which include establishment charges. Travelling charges, telegrams, office charges, dahabieh and furniture also come under the head of "Establishment charges."

Deducting "Pumping Stations" and "Land Charges," the figures become £E.55,001 for Establishment and £E.626,993 for Works. The same staff supervises the distribution of water, the preparation of projects, and the execution of the works.

EXPENDITURE 1899.

	1st Circle	2nd Circle	3rd Circle	Barrage	Total
ESTABLISHMENT CHARGES	£L.	£L.	£L.	£L.	£L.
Budget	17,576	16,471	15,919	4,395	54,361
Caisse (Drainage.	2,783	2,218	4,393	—	9,394
Weirs.	—	—	—	1,246	1,246
Totals.	20,359	18,689	20,312	5,641	65,001
WORKS.					
New Works.	1,734	553	1,376	338	4,001
Protective Works	6,054	9,092	10,540	1,856	27,542
Maintenance—Masonry	2,113	2,264	570	7,182	12,129
.. Hand-Earth-work.	50,231	53,592	35,588	—	139,411
.. Dredging.	25,025	16,547	13,138	—	54,710
.. Roads.	897	881	500	—	2,278
.. Gardens.	—	—	—	1,876	1,876
New Roads	9,399	15,361	184	—	24,944
New Drainage (Budget	14,219	18,090	16,960	—	49,179
Works. (Caisse.	11,137	50,441	43,801	—	135,379
Weirs—Caisse	—	—	—	158,627	158,627
Sharaki Prevention.	759	800	1,657	—	3,216
Ferry Fund Bridges	1,069	2,677	1,800	—	5,546
Pumping Stations	799	—	9,784	—	10,583
Land Charges	—	414	712	—	1,126
Wadi Tumilat Reclamation	7,132	—	—	—	7,132
Works for other Ministries.	933	—	—	—	933
	161,501	170,622	136,610	169,879	638,612
Total Establishment and Works.	181,860	189,311	156,922	175,520	703,613

MASONRY WORKS.

With few exceptions, most of them insignificant, all the New Works executed during the year come under the head of New Drainage Works, and have been described in Chapter III. The Weirs are described in Chapter IV. The following is a list of the exceptions :—

1st Circle.	£E.
Wooden bridge over Saidia Canal at Tawila	30
Head Sluice.—Bashkariet el Hazania.	195
.. Sahilia Canal	181
.. Mustagadda Canal.	221
.. Natara Canal	170
.. Um Nawar Canal	156
.. Sayda Canal	145
.. Three on Mansuria and two on Bahia Canals	332
.. Balad Canal	143
.. Goha Canal.	161
—	1,734

This represents half the cost, the other half being borne by Light Railways.

	<i>Brought forward.</i>	£E.1,734	
<i>2nd Circle.</i>		£E.	
Two wooden bridges on Taalib Canal.		53	
Dalgammu bridge over Baguriyah Canal (part of cost).		500	
		—	553
<i>3rd Circle.</i>		£E.	
Widening Sahel Markaz Canal (Land)		1,055	
Addition of Regulating Head to bridge over Shibrakhit		97	
Purchase of an Inspection House at Rahmania		100	
Wooden bridges Gammabia		60	
.. Dahri and Safr Khalid Canals.		64	
		—	1,376
<i>Barrages.</i>		£E.	
New Landing Stage.		250	
Meteorological Instruments		88	
		—	338
		£E.	<u>4,001</u>

The Dalgammu Bridge over the Baguriyah Canal is an iron bridge with a navigable opening, which is being built in accordance with an agreement made with the Railway Administration some years ago. Instead, however, of building the bridge itself, the Railway Administration has released itself from the obligation by paying a sum of £E.2,500 to the Irrigation Department. By a subsequent arrangement between the Irrigation Department and the Light Railway Company, the latter will now build the bridge, and the Company and the Irrigation will share the cost equally. The unspent balance of the £E.2,500 will be devoted to the building of another road bridge elsewhere.

The only other work in the foregoing lists, of sufficient importance to call for special remark, is the "Widening the Sahel Markaz Canal." When the two Khandaks took the place of the old Khatatbeh Canal, financial considerations affected the project injuriously, and the Khandaks and Sahel Markaz Canals were not given sufficiently large dimensions. The former have since been enlarged, but still the carrying power of the three canals is insufficient, even though they are often run with an undesirably high water level. A project has, therefore, been worked out to remedy this defect in the Beherah Irrigation system by means of the necessary enlargement of the Sahel Markaz Canal. As there was every probability of funds being made available for a commencement of the work in 1900, it was thought desirable to make a start in 1899 with land expropriation as a preliminary, and, as no special repair works on the Barrage itself were undertaken in 1899, the necessary transfer was made from the Barrage allotments. A small quantity of dredging was also done to create an immediate effect.

MAINTENANCE.

There was no work of any importance executed under this head, the conversion of Kafr Shoka Bridge on the Sahel Canal in the 1st Circle, costing £E.209, being the heaviest single item. The expenditure was all for ordinary repairs and closing planks and grooves. The 3rd Circle was prevented from spending as much as it should on existing masonry works, as its allotments are insufficient to meet the necessary expenditure on River Protection and Maintenance of Works. Either River Protection or Masonry Repairs must be sacrificed to the insufficiency of the allotments, and, as neglect of the latter has no such immediate and far reaching effects as neglect of the former, the repairs have to be postponed.

DREDGING BY MACHINERY.

The table, which follows, gives the quantities dredged in canals and drains for the past six years. Part of the dredging comes under the head of "maintenance," as being the annual work to keep the channels to their proper sections. The other part is not maintenance, as it consists of deepening or widening channels beyond their original sections, and is, consequently, considered "remodelling." All the dredging in drains and also the widening of the Sahel Markaz Canal comes under the head of remodelling.

In the 2nd Circle, the Bahr Tirah was dredged for the first time instead of being cleared by hand, as it was found to be as cheap and considerably more convenient to clear by dredging.

The cube dredged in the Rayyah Menufiyah was large, but was not a single year's deposit. The canal had not been properly cleared the year before, as the money allotted was short and the Inspector in charge failed to report the insufficiency of funds and ask for more—a serious omission in the case of the main feeder of the whole of the Central Delta, and the chief cause probably of much of the difficulty of distribution experienced in Gharbiyah during the summer of 1898.

For the first two kilometres of the Rayyah Menufiyah along which the stone spurs have been made up to the section and form decided on, there was found to be no deposit after the flood of 1899. This method of reducing deposit, which has succeeded so well on the Ibrahimiyah Canal in Middle Egypt, should, therefore, be persevered with.

The rate paid for dredging is 34 milliemes a cubic metre under the new contracts now in force.

Dredging by Machinery.

The following table gives the quantities dredged in canals and drains for the past six years:—

CANALS AND DRAINS	1893-1894	1894-1895	1895-1896	1896-1897	1897-1898	1898-1899
1ST CIRCULE	C.M.	C.M.	C.M.	C.M.	C.M.	C.M.
<i>Maintenance.</i>						
Isarivah	157,742	169,183	139,845	266,976	224,316	322,471
Sharkawyah	94,272	125,661	76,283	113,983	111,946	125,557
Basiriyah	150,374	156,088	124,182	132,293	183,487	152,854
Kharbarah	78,224	55,981	65,748	62,293	64,848	51,412
Wadi	5,987	25,212	—	93,888	—	—
Bahr Sakh	91,342	82,873	61,127	14,286	50,027	2,823
Bahr Mues	—	27,000	8,957	—	—	—
Mansurah lock	—	18,681	2,422	32,779	15,906	22,648
Total Maintenance	524,961	660,779	478,564	659,468	650,528	677,765
<i>Remodelling.</i>						
Townki	7,093	13,641	—	—	—	—
Saahyah lock	—	—	—	—	—	5,353
Suudhah	17,743	67,860	12,597	—	59,413	—
Bahr el Bagar drain	—	65,014	127,552	146,850	227,387	245,853
Bahr Lawi drain	—	—	—	—	—	116,793
Total Remodelling	22,836	142,515	139,859	146,850	277,800	367,912
Grand Totals	547,797	803,294	618,423	806,318	928,328	1,045,677
Expenditure £E	20,072	29,623	26,426	29,382	33,490	37,352
2ND CIRCULE						
<i>Maintenance.</i>						
Mesuriah	161,061	213,195	193,783	198,591	265,069	399,937
Kadd	15,674	130,794	—	—	112,678	—
Bahr Tash	—	—	—	—	—	74,810
Kaddah lock	7,923	15,000	7,629	11,577	6,979	10,530
Total Maintenance	187,658	358,989	201,412	210,168	384,726	485,277
<i>Remodelling.</i>						
Mohit drain (No. 1)	—	—	—	242,721	218,298	84,000
Penahash drain	—	—	—	—	—	114,000
Sharkawyah drain (No. 4)	—	164,700	15,688	—	—	—
Total Remodelling	—	164,700	15,688	242,721	218,298	198,000
Grand Totals	187,658	523,689	247,100	452,889	603,022	683,277
Expenditure £E	6,662	18,581	8,898	16,078	21,395	23,279
3RD CIRCULE						
<i>Maintenance.</i>						
Bahr el Bahar, Kharbarah Canal	349,799	369,855	422,631	439,275	230,916	185,982
Mansurah Canal	14,346	108,650	100,287	118,464	120,996	123,434
Mansurah, Kharbarah canals	—	9,893	12,472	6,936	11,066	—
Ummah Canal	—	—	—	59,615	—	37,980
Total Maintenance	—	—	—	—	—	347,396
<i>Remodelling.</i>						
Sah, Markoz Canal	—	—	—	—	7,652	54,398
Dunshah drain	—	—	—	8,558	—	5,863
Suudhah drain	—	—	—	7,600	—	—
Ummah drain	—	—	—	—	112,289	256,967
Ummah drain	—	—	—	—	18,509	—
Total Remodelling	—	—	—	—	—	317,228
Grand Totals	547,797	418,898	274,458	340,151	531,368	664,624
Expenditure £E	—	—	11,156	12,611	19,561	21,876

The Isarivah column for 1898-1899 includes some extra metres excavated before the start of the Suudhah branch, and is not included in the above.

The Drainage Works done by dredging, entered in the foregoing table, are also included in the Lists of Drainage Works in Appendices B, D, and F.

The totals extracted from these tables are :

DREDGING ON ALL ACCOUNTS	1st Circle	2nd Circle	3rd Circle	TOTALS
	C M	C M	C M	C M
Maintenance canals & drains . . .	677,765	185,277	347,396	1,510,438
New or remodelling irrigation works	5,353	—	51,398	59,751
.. .. drainage works	362,559	198,000	262,839	823,389
Totals . . .	1,045,677	683,277	664,624	2,393,578

EARTHWORK BY HAND.

The quantities and cost of earthwork executed by hand during 1899 in the ordinary maintenance of canals, banks and drains are given in the following statement:—

CIRCLE.	Cubic metres.	Cost, £E.	Meaning. Pistons	Earthwork— maintenance.
1st Circle.	3,154,114	48,710	1.54	
2nd	2,862,504	53,211	1.83	
3rd	2,128,693	34,611	1.63	
Totals . . .	8,145,311	136,535	1.67	

In the 1st Circle a further payment of £E.1,521 was made for work done in 1898 but not paid for, making a total expenditure for the year 1899, under this head, of £E.50,231.

The quantities and cost of hand-work executed under the head of New Drainage Works was as follows:—

CIRCLE.	Cubic metres.	Cost, £E.	Meaning. Pistons	Earthwork— New drainage works
1st Circle	1,682,353	27,970	1.66	
2nd	1,822,472	25,161	1.33	
3rd	978,645	15,876	1.62	
Totals . . .	4,483,470	69,010	1.54	

Total quantities of Dredging and Earthwork on all Accounts.

Grand totals, earthwork. Collecting the quantities of earthwork, done under the different heads, and expenditure, we get the following figures for 1899 :—

<i>Dredging.</i>		c.m.
Maintenance canals and drains		1,510,438
New or remodelling Irrigation Works.		59,751
.. Drainage Works		823,389
		<hr/> 2,393,578
<i>Hard Work.</i>		
Maintenance banks, canals and drains		8,145,311
New or remodelling Irrigation Works.		—
.. Drainage Works		4,483,470
		<hr/> 12,628,781
Total cubic metres.		<hr/> 15,022,359

IVER AND CANAL PROTECTIVE WORKS.

There has been a slight decrease in expenditure on river protective works, but it is still heavy.

The detail of the expenditure is as follows :—

<i>1st Circle.</i>	£E.
Bridges.—Protection from down-stream scour	226
River.—Spurs and revetments, Kaliubiyah	1,107
.. .. Dakahliyah	4,721
	<hr/> 6,054
<i>2nd Circle.</i>	
River.—Spurs and revetments, Gharbiyah	5,610
.. .. Menufiyah	2,610
.. .. stone purchase	589
Canal.—Planting Rayyah Menufiyah slopes.	283
	<hr/> 9,092
<i>3rd Circle.</i>	
River.—Spurs and revetments, Beherah.	4,730
.. .. Gizah	2,409
Sacks for Gizah	92
Canal.—Rayyah Beherah planting	532
.. Nubariyah planting	51
.. Rashidieh sand drift	24
Sea Wall.—Abukir Sea Wall	2,226
Bank.—Mariut Causeway	476
	<hr/> 10,540
<i>Battergate.</i>	
River training and protection	1,856
Total.	<hr/> £E. 27,542

The Rayyah Menufiyah slopes are being planted with the object of preventing the sides of the canal from being washed into the centre of the channel every flood season, and it is hoped that, in time, by this means, assisted by a uniform system of stone spurs, we may obtain the same effect on the annual silt deposit as was obtained by similar means in the Rayyah Beherah.

The Abukir Sea Wall was considerably damaged by violent storms during the winter and required extensive repairs. The stone employed in the sea wall is not of sufficiently large dimensions for the work it has to do.

Mariut causeway had been much damaged by wave erosion during the same violent winter storms, and the stone revetment throughout its length had to be renewed.

AGRICULTURAL ROADS.

Construction of new Roads.

There were added in 1899 174 kilometres of new roads to the 1344½ made up to the end of 1898. The following statement brings the record up to date :—

CIRCLE AND PROVINCE.	Existing at end of 1898.	Added during 1899	Total at end 1899
	Kilometres.	Kilometres	Kilometres.
<i>1st Circle.</i>			
Kaliubiyah	51	56	107
Sharkiyah.	177	—	177
Dakahliah	142	27½	169½
<i>2nd Circle.</i>			
Menufiyah.	231½	20½	252
Gharbiyah.	461½	70	531½
<i>3rd Circle.</i>			
Beherah	281½	—	281½
Totals	1,344½	174	1,518½

The expenditure on new roads during 1899 was :—

	£E.
1st Circle	9,390
2nd	15,361
3rd .. (land charges of previous years).	184
Total	£E.24,935

Maintenance of Roads.

There is no adequate provision for the maintenance of these roads and, as I have pointed out in previous Reports, they are *not* properly maintained, the small sums allotted to this maintenance being obtained at the expense of the Irrigation Budget.

It will be clear from the following figures that the road maintenance is not sufficiently provided for :—

	Roads completed at end of 1898.	Sum spent on Maintenance in 1899
	Kilometres	£ E.
1st Circle	370	897
2nd	693	881
3rd	281½	500
Totals ..	1,344½	2,278

By my No. 2960, dated 18 November, 1899, to the Under Secretary, I made proposals for the formation of a Road Branch of the Public Works Department to have the care of the roads in Lower Egypt and the Fayoum. I estimated the annual sum required for Staff and Work at £E.20,000, and I proposed to raise the money, if not otherwise obtainable, by a road cess of seven millièmes per feddan on the three million feddans of land in Lower Egypt and the Fayoum, which have contributed to the construction of the roads. The Irrigation Budget would thus be relieved of charges which do not properly belong to it, and the roads would be properly cared for. Under present arrangements they are neglected, and those in charge of them cannot be held responsible for this unsatisfactory state of things.

BRIDGES TO REPLACE FERRIES.

Under this head there was a total expenditure of £E.5,546, distributed between the different Circles as below:—

	£E.
1st Circle	1,069
2nd Circle	2,677
3rd Circle	1,800

The bridges on which this expenditure was incurred were the following:—

1st Circle.

A bridge, with navigable opening over the Bahr Saghir at Dekernes, to carry general traffic and also the Light Railway, was built in 1898,

and the cost was shared equally between the Light Railway and the Ferry Fund. The sum of £E. 1,069 is the amount of the half share.

2nd Circle.

The unpaid balance on one bridge, and the cost of two others, begun in 1898 and finished in 1899, make up the sum of £E.2,677 as detailed below.

	£E.
Over Kotni Canal at Min-hillin, unpaid balance of 1898.	126
Over Kasid Canal at Melig	1,083
Over Bagurivah Canal at Bagur	1,468
Total	<u>£E.2,677</u>

3rd Circle.

Two bridges were commenced and partly paid for namely—

	Expenditure during 1899.
Bridge at Teriyah over the Rayyah Beherah, estimated at £E.1,900	£E. 1,200
Bridge at Rahmaniya over the Sahel Markaz Canal. Estimate £E.1,100	600
Total	<u>£E.1,800</u>

These two bridges will be completed and fully paid for in 1900.

NAVIGATION.

Effect of opening Sanaytah Lock.

The Sanaytah Lock and Regulator on the Mansuriyah Canal was connected up with the existing channel above and below it on 9th February, 1899.

The completion of this work removes the obstruction to through navigation by canal from above the Barrage to the Nile at Mansurah. The old dilapidated regulator, which had no lock attached, has been replaced by the new work, and ferries have been substituted for the temporary fixed bridges along the canal.

The tolls collected in 1898 at the Rayyah Tewfiki Head and at the Mansurah Lock totalled up to £E.1,704; in 1899 to £E.4,287; figures which show how the navigation along the canal has increased in consequence of the construction of the Sanaytah work.

By a misprint this Bridge was shown in last year's report as belonging to the 3rd Circle instead of the 2nd.

WORKS FOR OTHER MINISTRIES.

The work done for the Finance Ministry consisted of the filling of hollows to prevent illicit salt production, on which £E.133 was spent. Besides this, £E.800 was expended for the New Quay Wall and road at Matarieli on Sahel Menzaleh; this expenditure was payment for work done in 1898. This new work is a great improvement on the previously existing state of things and, in connection with the Light Railway, should greatly favour the development of the fish trade.

CHAPTER VI.

THE WADI TUMILAT.

Previous-
history.

The Wadi Tumilat, which lies alongside the railway from Abbasa, west of Tel-el-Kebir, to Ismailiyah, has changed hands many times since it was known as the Land of Goshen, where the sons of Jacob grazed their flocks. In those days, probably an overflow channel from the Nile inundated the valley annually during the flood, and afterwards drained the lands into Lake Timsah on the waters subsiding. The flooded lands no doubt, as soon as the waters retired, grew green with fine pasturage, and held in their lowest hollows lakes of sweet water for cattle to drink. So that for Jacob's sons, who were shepherds, the valley was "the best of the land."

The Estate known as the Wadi Teftish, lies in the upper part of this valley between Abbasa and Kassassine. In Mohamed Ali's time its total area was 21,918 feddans, of which rather less than a third appears to have been cultivated, if the extracts which follow can be trusted.

The lands were irrigated by the Wadi canal, which Mohamed Ali is said to have created.

In a work entitled "L'Egypte" published by Mr. Felix Paponot in 1884, some information is given concerning the ownership and development of the Wadi Tumilat Estate. Though Mr. Paponot was personally acquainted with the Estate, the information he gives is chiefly taken from a paper by Mr. Guichard (who managed the Estate for the Suez Canal Company), published in December, 1881, in the

Nouvelle Revue under the title of "Colonisation de l'Isthme de Suez (1861-1866)." The following are extracts from this paper:

" Le domaine, ou Chiflick de l'Ouady, d'une contenance de 10,000 hectares, a été créé par Mehemet-Ali. Le fondateur de la dynastie régnante d'Égypte revenait de Syrie par la route de Kantara de Salahieh; il se rapprochait de Bulbeis lorsqu'il apprit qu'une conspiration était ourdie contre lui et devait éclater aussitôt après son retour au Caire. Il résolut de s'arrêter à l'endroit où il se trouvait, à Tel-el-Kébir, centre de l'Ouady (le *Pitoun de la Bible); de là, il dépêcha ses lieutenants au Caire pour déjouer les projets de ses ennemis.

" L'inaction était insupportable à Mehemet-Ali. Son activité avait sans cesse besoin de créer ou d'améliorer; la vallée où il campait attira son attention: l'état en était déplorable; les eaux provenant des irrigations de la Province de Charkieh formaient des marais pendant la crue du Nil, mais, durant sept mois de l'année, la terre restait desséchée. Jugeant rapidement le parti qui pouvait être tiré de l'aménagement des eaux, Mehemet-Ali donna l'ordre d'élever en amont de la vallée une grande digue courant du sud au nord; puis il fit creuser un canal principal sur une longueur de 35 kilomètres, en même temps que les canaux nécessaires à la distribution et à l'écoulement des eaux. Ces travaux furent exécutés en quelques mois. La vallée une fois assainie, le Vice-Roi y implanta une colonie agricole, par la force, suivant son habitude.

" Il refoula dans le désert les Bédouins Toumilat, les anciens occupants du sol, qui étaient toujours en guerre avec les autorités turques; puis il fit prendre dans les diverses parties de l'Égypte 16,000 Fellahs, qui furent installés dans l'Ouady et contraints de cultiver non seulement les produits usuels du pays, mais le coton et l'indigo dont il s'agissait d'essayer l'acclimatation.

" Le château de Tel-el-Kébir fut élevé à l'endroit même où le Vice-Roi avait campé: on construisit un village avec une mosquée, des magasins généraux, un vaste établissement pour les fonctionnaires.

" Le domaine était en pleine prospérité à la mort de Mehemet-Ali; mais, après lui, sous Abbas, la plus grande partie des Fellahs transportés dans l'Ouady désertèrent pour retourner dans les Provinces d'où ils avaient été tirés. Au commencement du règne d'Abbas Pacha, les Bédouins étaient en faveur, particulièrement les Anadis, tribu puissante qui avait aidé Mehemet-Ali dans sa lutte contre les

* Tel-el Maskutah was "Pitoun" not Tel-el-Kébir.

Tures ; ils furent autorisés à occuper la vallée abandonnée ; mais bientôt les caprices du Vice-Roi indisposèrent les nouveaux colons de l'Ouady ; moins patients que les Fellahs, ils se mirent en pleine révolte. Les troupes envoyées contre eux ruinèrent la contrée ; la population décimée s'enfuit. 12,000 Anadis firent leur exode et se réfugièrent en Syrie.

“ Abbas étant décédé, le domaine échut à son fils Elami Pacha, gendre du Sultan. Ce prince mourut peu de temps après son père, laissant une succession fort obérée. Saïd Pacha, héritier du trône, se porta garant de toutes les dettes de son neveu et prit possession du domaine de l'Ouady.

“ En 1861, M. de Lesseps songea à acquérir cette propriété pour le compte de la Compagnie de Suez, afin d'avoir la jouissance du canal d'eau douce qu'il était urgent d'amener jusqu'à Suez, parallèlement aux travaux du canal maritime que l'on devait exécuter en plein désert ; il était destiné à l'alimentation des travailleurs ainsi qu'aux transports des matériaux. La vente fut consentie par le Vice-Roi au prix de deux millions de francs.”

“ Sa prospérité avait été toujours croissante depuis 1861. L'expérience des locations avait complètement réussi. En 1865, les baux de trois ans étaient renouvelés. Le revenu était quadruplé et porté à 650,000 francs ; il était destiné à augmenter encore dans la période suivante. Les impôts à payer au Gouvernement étaient à la charge des locataires. La population recensée accusait 14,000 habitants repartis dans plus de soixante villages ; elle se composait principalement de fellahs venus des provinces de l'Égypte, des bédouins Anadis, et des Toumilat...”

Mr. Paponot, after quoting the above, goes on to remark :

“ La vallée de Gessen est, par le fait seul de l'altitude de sa position, le point où viennent s'accumuler les eaux de tout le versant ouest de la Province ; aussi sa fertilité est-elle assurée si, avec la facilité qu'elle a d'avoir de l'eau en abondance, on lui assure l'écoulement du trop-plein. C'est ce qu'avait compris la Compagnie de Suez et ce qu'elle avait essayé de réaliser.

“ Aussi, nonobstant les dispositions spéciales de petites rigoles qu'il est indispensable de faire ou de réparer et que possédait déjà le domaine de l'Ouady pour ses irrigations et desquelles nous n'avons pas à nous occuper, nous avons indiqué l'opportunité (en regard à l'achèvement alors prochain du grand canal Ismailieh) de projeter une rigole d'écoulement qui partait d'Abasch près d'Abou-Hamet, suivait le fond de la

vallée en contournant les pieds des dunes et venait aboutir au lac Maxhamah; puis de là, afin d'assurer désormais au lac un niveau constant et capable de l'empêcher de nuire aux terrains bas environnants, cette rigole continuait à parcourir le thalweg de la vallée en passant dans les bassins inférieurs de Rhamsis, Mackfar et enfin de Bir-Abou-Ballah, pour aboutir aux Lacs Amers vers le Sérapéum, en empruntant le petit aqueduc qui a été judicieusement prévu et exécuté en 1865 par la Compagnie vers Bir Abou-Ballah, sous le canal d'eau douce qui va à Suez, ainsi que celui qui a été ménagé sous la voie ferrée."

At the time that the Suez Canal Company purchased* the Estate according to M. Paponot, out of the total of 22,000 feddans comprised in it, only 6,000 feddans were under cultivation, yielding at the most a revenue of £E.4,000 and containing a population of about 4,500 souls. But four years later, in 1866, the Company had so wrought that the population was increased up to 14,000 inhabitants (including 4,500 Bedouins), and the cultivated area had grown to 12,000 feddans, returning a revenue of 650,000 Francs (£E.26,000).

The Ismaïlyah Canal has been the ruin of the valley by causing excessive infiltration from the high level water carried in it alongside the lands of the Estate lying below it. The Suez Canal Company, after having been instrumental in getting the Ismaïlyah Canal constructed and thus establishing a permanent cause of deterioration to be combated by future managers of the Estate, handed the property back to the Khedive Ismail Pasha on terms altogether favourable to the Company and the reverse to the Khedive. In 1865 Ismail Pasha made over the Estate to the Ministry of Public Instruction, converting the land into "Wakf."

In 1891 the Estate was surveyed, and the area was found to be made up of the following classes of land:—

Cultivable land leased	7,560 feddans
Cultivable if reclaimed, but uncultivated	9,972 ..
Occupied by canal and uncultivable wastes,	3,007 ..
Total	<u>20,539 ..</u>

It thus appears that since Mohamed Ali's time, when the total area of the Estate was 21,918 feddans, 1,380 feddans have been lost to the

*The amount of the purchase money is not stated, but Mr. Cameron in his "Egypt in the Nineteenth Century" gives the sum for which the land was purchased by the Company at £E 74,000 and that for which it was sold as £E 300,000.

Estate. This diminution is said to have been partly caused by sand encroachments and partly by the sale of lands under the Kharag El-Zinnam Decree of 9th September, 1884, with what truth I cannot say.

A project for reclaiming the lands thrown out of cultivation was prepared and its execution commenced in 1892.

The details of this project were described in the Irrigation Report for 1894 (p. 112) and subsequent Reports. The main features of the project were a pumping station at Kassassine and a central drain down the valley. No result followed from the execution of the project, as the Ministry of Public Instruction were not able to take advantage of the opportunities of drainage afforded for want of capital at its disposal.

Attempts to lease the Estate to a Company, or other body that would undertake the reclamation, failed, as an agreement as to the terms of the lease could not be arrived at with any of those who came forward with offers.

Present
arrangement.

But, finally, what promises to be a satisfactory arrangement was made. By Khedivial "Ordre Supérieur" No. 1, dated 2nd March, 1899, the Wadi Tumilat Estate was placed temporarily for a period of eleven years, under the direction of the Ministry of Public Works in order that works of reclamation and drainage might be carried out.

The estimated expenditure for the works of improvement (exclusive of staff included in the annual cost of maintenance) amounts to £E.62,189, made up as follows :-

	£E.
(1) Enlargement of pumping station	6,000
(2) Enlargement by widening and deepening of the main drain above and below the pumps, lowering the floor of the railway bridge near Ismailiyah and constructing a new siphon under the Suez Sweetwater Canal	17,000
(3) Completing branch and making field drains	15,189
(4) Remodelling irrigation system	10,000
(5) Purchase of dredger and agricultural machines	2,500
(6) Staff and farm buildings	8,500
(7) Steam ploughing, staff expenses and sundries	3,000
Total . . .	£E.62,189

It was estimated that, during the first year's working, there would be a deficit in the Estate accounts of £E.3,640, and in the second year of £E.2,159, or a total of £E.5,790, which must be added to £E.62,189, to obtain the total capital to be provided, viz., £E.67,979. This amount of capital it is proposed to expend in the first five years.

The annual maintenance charges have been taken at the following figures :—

	£E.
Staff	2,000
Pumping	2,500
Maintenance of channels	1,000
Taxes	5,850
Payment to Public Instruction	8,000
Total.	£E.19,350

The receipts* of the Estate for the year previous to the transfer were assumed, in the calculations made, to amount to £E.15,710 (the real figure was 15,748); and the area of cultivated and leased land was taken as 8,000 feddans (found since to be actually only 6,917). The area susceptible of reclamation was put down as 10,000 feddans; it was assumed that this would be reclaimed at the rate of 1,000 feddans a year, beginning with the second year.

The arrangement made is to be found detailed in letter No. 21, dated 6th March, 1899, from the President of the Council of Ministers to the Minister of Public Works. It lays down that the Wakfs Administration has to advance the amount required for the reclamation works: the annual maintenance, amounting to £E.19,350, will be paid from the yearly increasing annual receipts, the deficit of the first two years being met from capital expenditure. It is calculated that the receipts will increase to such an extent that, by the end of the eleven years, the amount advanced by the Wakfs will have been repaid almost in full. If any balance still remains to be repaid, the Wakfs Administration will be re-imbursed from the surplus of the receipts of the Estate after it assumes the direction of it at the expiry of the eleven years. It is also calculated that, at the end of this period, the receipts will have risen from the present figure of £E.15,710 to £E.32,250 at least, so that, instead of a deficit of £E.3,640, there will be a surplus of £E.12,900 or more.

The management of the Estate under this new arrangement has been entrusted to Mr. J. Langley, Inspector of Irrigation, in whose Circle the Estate lies. Musa Bey Ghaleb, Director of Works, was appointed in April, 1899, to be the Resident Director, and, under the orders of Mr. Langley, to take charge of both the reclamation and improvement works, and also the general management of the Estate.

The following table shows the forecast of results given in Sir William Garstin's Note preceding the agreement. The figures representing

NOTE.—The average of the annual receipts from 1881 to 1890 inclusive is £E.15,047. The receipts were highest during the four years from 1891 to 1894, for which period the annual average is £E.19,825, the maximum of £E.20,587 having been reached in 1894.

the rents of the land, used in his calculations, were low, and will, not improbably, be improved upon :

FORECAST OF RESULTS.

Receipts.

YEAR.	Expenditure	On present cultivated land	On land to be reclaimed.	TOTALS	Surplus	Deficits
	£ F.	£ F.	£ E.	£ E.	£ E.	£ E.
1st	19,350	15,710	Nil.	15,710	Nil.	3,640
2nd	19,350	17,000	200	17,200	Nil.	2,150
3rd	19,350	19,000	700	19,700	350	—
4th	19,350	21,000	1,500	22,500	3,150	—
5th	19,350	21,000	2,750	23,750	4,400	—
6th	19,350	21,000	4,000	25,000	5,650	—
7th	19,350	21,000	5,250	26,250	6,900	—
8th	19,350	21,000	6,500	27,500	8,150	—
9th	19,350	21,000	7,750	28,750	9,400	—
10th	19,350	21,000	9,000	30,000	10,650	—
11th	19,350	21,000	11,250	32,250	12,900	—

First year's results of new arrangement

There is some uncertainty as to which year should be considered the "1st year" of the above table, but as the new arrangement was not concluded till March, 1899, and Musa Bey was not appointed till April, and, further, as the leases entered into by the Ministry of Public Instruction did not expire till the 31st October, 1899, the first year of the eleven-year period might be fairly considered as commencing on 1st November, 1899. But as the first year of the Table shows no increase of receipts, and expenditure of the capital commenced before 1st November, 1899, I will, for comparison of results, take the first year of the table as ending on the 31st October 1899. The new leases are made for three years, so that a revision of the rents will not be made again until 31st October, 1902.

YEAR.	Estimate of Receipts		Estimate of Deficits and Surpluses	
	Original.	Revised	Original	Revised
	£ E.	£ E.	£ E.	£ E.
1st Year .	15,710	16,022 (Actual)	3,640 Deficit.	*230 Deficit. (Actual.)
2nd Year .	17,200	19,451	2,150 Deficit.	101 Surplus.
3rd Year .	19,700	20,236	350 Surplus.	886 Surplus.

Cost of pumping	£ E
Less charged to P.W.D. Budget	1,224
Net surplus shown	789
	(%)

The deficit of 1899 ought really to appear as £E.1,029, that is, the cost of pumping £E.1,224 less £E.195 shown in the revenue account as balance credit. But, as the accounts stand, L.E.799 of this amount is charged to the Public Works Budget, as the pumping was done in the early part of the year before the new arrangement had been concluded. £E.425 has been debited to capital account, while £E.195 has been shown as surplus in the Revenue Account.

It will be seen from the foregoing figures that the present prospect shows an improvement on the original forecast. After the third year, when the revision of leases will take effect, it is hoped that the improvement will be still more marked.

As regards the area of reclamation taken in hand, the forecast is also being surpassed, as the following statement shows, the forecast allowing for the reclamation of 1,000 feddans a year only.

Leased area in 1898	6,917 feddans.
.. .. added in 1899	<u>1,856</u> ..
Total leased area in 1899.	8,773 feddans.

Some of the added land is in scattered plots adjacent to previous cultivation, but 1,195 feddans is in one block at Kassassine near the pumps, and forms the first block to be reclaimed. It is rented at 25 P.T. a feddan the first year, 50 P.T. for the second and 75 P.T. for the third year.

It is proposed to take up 2,000 more feddans in 1900.

Against the credit for improvement and reclamation works, which may be considered "capital account," the following was the expenditure of the year:—

<i>Drainage Works.</i>		£E.
Enlargement of pumping station		1,053
Enlargement of main drain		870
Branch and field drains		30
		<hr/>
		2,003
<i>Remodelling Irrigation System.</i>		
Earthwork, Sanduk and Wadi Canals.		577
5 regulators and 8 sluices		838
Pipes and bridges		246
		<hr/>
		1,661
<i>Purchase of Plant.</i>		
2 engines and a seven-tyne cultivator		1,458
		<hr/>
		1,458
<i>Staff and Farm Buildings.</i>		
3 Ezbehs (100 rooms).		210
4 houses for staff		1,050
		<hr/>
		1,260
<i>Staff Expenses and Sundries.</i>		
		325
<i>Working Expenses (from Revenue Account.)</i>		
Kassassine pumps		<u>425</u>
Total . . .		£E.7,132

The original pumping station consists of two 30-inch centrifugal pumps. It is proposed to add to this at once a 20-inch pump, and later on, if found necessary, another 30-inch pump. During 1899 the 20-inch pump was ordered and delivered. The new foundations have been built in 1900 and provide for the erection of the additional 30-inch pump as well as the 20-inch. The floor of the suction well has been put in twenty centimetres lower than that of the first pumps.

The main drain has been enlarged above the pumping station to a 10-metre bed from kilometre $1\frac{1}{2}$ to kilometre $4\frac{1}{2}$. Its original bed width was 4 metres and bed level at the pumps was R.L. 2.40. This latter has now been lowered to R.L. 1.70, and the bed has been given a slope of $\frac{1}{20000}$. The first one and a half kilometres of drain from the pumps had been previously widened. The remodelling allows for draining the lowest lands, and for a discharge of three cubic metres a second with a water depth of one metre.

The branch and field drains for an area of 1,500 feddans were dug.

The canal remodelling works consisted of a new head to the Sanduk Canal on the Ismailiyah at Kassassine, and for other regulating works : prolongation of the same canal and the suppression of three kilometres of the old Wadi Canal and the substitution of new channels in its place.

The staff houses consist of dwelling rooms for the Director, built as an upper storey to the office at Tel el Kebir : an inspection house, also at Tel el Kebir, for the Inspector : and houses at Kassassine and Abbassa for the Mamours and Sarrafs of those Districts.

The general result of the nine months administration of the Wadi under the new arrangement is encouraging and creditable to both Mr. Langley and Mussa Bey Ghaleb.

For convenience of future reference the following statement is given showing the Receipts and Expenditure in detail. The expenditure against the Improvement and Reclamation Credit (Capital Account) has already been given.

It may be as well to record that, when the new Direction took over the management of the Estate, the outstanding arrears of rent from 1888 to 1896 amounted to £E.26,574; and the whole of this appears to be irrecoverable, as there is no security to make recovery possible.

REVENUE ACCOUNT.

RECEIPTS.		£E.
Rent of 6.917 feddans		15,341
.. of palm trees		169
.. of grazing		250
.. of wild "Samar" grass		160
.. of garden and house		8
.. of incubator		15
Sundry		79
Total. . . .		<u>£E.16,022</u>

EXPENDITURE.		£E.
Staff.		1,753
Taxes		5,876
Payment to Public Instruction		8,000
Agricultural road contribution		117
Compensation for crops destroyed		15
Perty expenses		66
Balance credit to be carried forward		195
Total. . . .		<u>£E.16,022</u>

The above account shows a surplus of £E.195, but this is obtained by charging the pumping to capital account. If the pumping had been charged to this account, there would have been a deficit of £E.230 shown.

The pumping expenditure of 1899 was thus charged:—

	£E.
To Public Works Budget	799
To Wadi Capital Account	<u>425</u>
Total. . . .	£E.1,224

The real deficit of the above revenue account is, therefore, £E.425 — 195 = £E.230, and would have been £E.1,224 — 195 = £E.1,029, if all the pumping expenditure for the year had been charged to the Wadi account.

R. H. BROWN.

May, 10th, 1900.

APPENDICES.

APPENDIX A.

ABSTRACT OF ACCOUNTS, 1899—IRRIGATION DEPARTMENT.

Lower Egypt.

BUDGET HEAD	1st Circle	2nd Circle.	3rd Circle.	The Barrage.	TOTALS.
	£E. Mill.	£E. Mill.	£E. Mill.	£E. Mill.	£E. Mill.
REGULAR BUDGET.					
<i>Establishment.</i>					
Classified staff	8,881,658	8,000,757	8,030,603	1,380,748	26,293,826
Unclassified staff	4,256,467	3,698,460	3,137,183	2,483,699	13,575,809
Travelling charges	2,727,784	3,100,052	2,779,421	31,370	8,638,628
Telegrams	202,360	259,947	91,960	5,305	562,570
Dahabiyahs	345,747	15,030	132. —	—	522,783
Office charges and furniture . .	461,089	108,930	362,962	26,666	959,647
<i>Works.</i>					
New works	800. —	—	1,054,830	—	1,854,830
Flood protection works	6,054,417	8,808,661	6,956. —	—	21,819,078
Maintenance and repairs	4,279,720	3,675,949	3,378,281	11,273,372	22,607,322
Repairs of roads	897,300	821,733	500. —	—	2,219,033
Maintenance of drains	4,559,500	6,358,772	3,000. —	—	13,918,272
Pumping stations	799,284	—	9,566,279	—	10,365,563
Corvée abolition works	39,180. —	10,436,697	31,878,901	—	111,495,598
Totals, Regular Budget.	73,445,326	75,311,993	70,871,480	15,201,160	234,832,959
<i>Corvée Budget.</i>					
Corvée abolition works	46,000. —	41,998,102	33,998,887	—	121,996,989
<i>Agricultural Roads.</i>					
New roads	9,398,974	15,360,909	184,045	—	24,943,928
<i>Ferry Fund.</i>					
Bridges to replace ferries	1,068,782	2,676,959	1,800. —	—	5,545,741
SPECIAL GRANTS BY CAISSE FROM GENERAL RESERVE.					
Drainage works	43,919,662	52,659,405	48,193,501	—	144,772,568
Sharaki prevention	759,397	800. —	1,657,405	—	3,216,802
Weirs below the Barrage	—	—	—	159,872,930	159,872,930
Totals, other grants	101,146,815	113,495,375	85,833,838	159,872,930	460,348,958
Grand Totals	174,592,141	188,810,368	156,705,318	175,074,090	695,181,917

APPENDIX B.

ABSTRACT OF DRAINAGE WORKS EXECUTED IN 1899 IN 1ST CIRCLE.

NAME OF DRAIN	Length in kilometres		Earthwork.			Land			Expenditure on Works.	Total Expenditure
	New channel	Remodelled channel	Dredging	Hand-work.	Cost	Area given.	Area purchased	Cost.		
			CM.	CM	£ E.	FED.	FED.	£ E.	£ E.	£ E.
BAHR EL BAGAR SYSTEM.										
Main drain.	—	32 $\frac{1}{2}$	245,853	—	8,359	—	—	—	1,061	9,420
Bordein branch.	—	—	—	—	—	—	—	—	36	36
Bilbeis branch.	9 $\frac{3}{4}$	—	—	114,781	729	—	—	—	777	1,506
ARIN SAN SYSTEM.										
Main Arin.	—	16	—	511,111	9,200	11 $\frac{3}{4}$	37 $\frac{1}{8}$	98	819	10,117
Natura branch.	4	5	—	64,634	1,034	—	—	14	392	1,440
BAHR SAFT SYSTEM.										
Main (Saft) drain.	—	—	—	—	—	—	—	—	1,004	1,004
Irrigation channel Gommezet Bargut.	6 $\frac{1}{4}$	—	—	18,968	265	8 $\frac{1}{2}$	5 $\frac{1}{2}$	51	328	644
Akrash branch.	6	—	—	73,552	1,030	27 $\frac{1}{4}$	22 $\frac{3}{4}$	—	197	1,227
Menharut branch.	1 $\frac{1}{2}$	—	—	4,389	61	12	—	—	111	172
Mebasher branch.	6	—	—	72,874	1,021	28 $\frac{3}{4}$	13	—	147	1,168
NIZAM HADUS SYSTEM.										
Main Bahr Tawil.	—	2 $\frac{1}{4}$	116,406	—	3,968	—	—	—	—	3,968
Balamun branch.	13 $\frac{1}{4}$	—	—	122,370	1,836	34 $\frac{1}{4}$	35	516	550	2,902
Main Nizam.	—	21	—	345,459	5,527	7 $\frac{1}{4}$	18 $\frac{1}{2}$	45	240	5,812
Baklia branch.	—	—	—	—	—	—	—	356	357	713
Sanayta works.	—	—	—	110,233	3,307	—	—	6	1,727	5,040
Mansurah branch.	11 $\frac{1}{4}$	—	—	41,266	619	8 $\frac{1}{2}$	14	12	944	1,605
SIFT SYSTEM										
Sayala & Rashmun branches	2	8 $\frac{1}{4}$	—	202,716	3,341	5	22	341	909	4,591
MISCELLANEOUS										
Boundary stones.	—	—	—	—	—	—	—	—	—	100
Land.	—	—	—	—	—	—	—	—	—	3,890
Staff and Sundries.	—	—	—	—	—	—	—	—	—	2,783
TOTAL	50	84	362,659	1,682,343	40,297	128$\frac{3}{4}$	122$\frac{1}{4}$	1,469	9,599	58,138

APPENDIX C.

DETAIL OF EXPENDITURE ON WORKS.

NAME OF DRAIN	DESCRIPTION OF WORK.	EXPENDITURE.	TOTAL.
		£F.	£E.
BAHR-EL-BAGAR SYSTEM.			
Main drain	2 pipe aqueducts	269	1,061
	1 syphon repaired	75	
	Gohena railway bridge alteration	717	
Bordein branch	1 railway diversion		36
Bilbeis branch	16 pipe aqueducts	277	777
	Boundary stones	340	
	8 wooden bridges	160	
ARIN SAN SYSTEM.			
Main drain	12 pipe aqueducts	181	819
	12 wooden bridges	600	
	Balance due on Nawafaa syphon	38	
Natura branch	4 pipe aqueducts	252	392
	4 wooden bridges	140	
BAHR SAFT SYSTEM.			
Main drain	2 escape	384	1,004
	2 sluices	240	
	Balance due from 1898	380	
Irrigation channel Gomme- zer Bargut.	4 pipe aqueducts	47	328
	1 wooden bridge	16	
	1 masonry head	265	
Aktash branch drain	6 pipe aqueducts	69	197
	8 wooden bridges	128	
Menharit branch drain.	1 pipe aqueduct	11	111
	1 masonry head	100	
Mebashir branch drain	3 pipe aqueduct	35	147
	7 wooden bridges	112	
Carried forward			4,872

DETAIL OF EXPENDITURE ON WORKS (*continued.*)

NAME OF DRAIN.	DESCRIPTION OF WORK	EXPENDITURE.	TOTAL.
		₹E	₹E
	<i>Brought forward</i>		1,872
NIZAM HADUS SYSTEM.			
Balamun branch.	16 pipe aqueducts	390	
	6 wooden bridges	160	550
Main Nizam	4 wooden bridges		240
Baklia branch.	Balance due to Contractor from 1898.		357
Sanayta works.	1 iron lift bridge		1,727
	2 pipe aqueducts.	130	
Mansura branch	1 wooden bridge	20	
	1 railway diversion	83	
	1 road bridge	711	944
SIGU SYSTEM.			
Sayala and Bashmur branches	12 pipe aqueducts	670	
	Kilo marks and pitching	14	
	3 wooden bridges	255	909
	TOTAL		9,599

APPENDIX D.

ABSTRACT OF DRAINAGE WORKS EXECUTED IN 1899 IN THE 2ND CIRCLE.

NAME OF DRAIN OR IRRIGATION CHANNEL	Length in kilometres.		Earthwork, including dredging		Land			Expendi- ture on works	Total Expendi- ture.
	New channel.	Re-model- led channel.	Cube.	Cost.	Area given	Area pur- chased.	Cost		
				£l. Mill.			£l. Mill.	£l. Mill.	£l. Mill.
BAHR SHIBIN SYSTEM									
Muhit drain	—	4.00	34,000	1,156,000	—	9 16 2	270 247	1,002 591	2,408,838
Batra drain	—	25.00	91 271	1,232 193	—	—	—	823,501	2,055,700
Nawia drain	13.00	—	165 112	2 167 407	—	64 20 20	2,370 611	1,320 800	5,858,817
Talkha drain	3.60	—	12,354	172 956	6 9 8	4 12 20	104,376	305 94	583 295
Demillash drain	—	29.40	273,400	6,344 000	9 10 10	2 10 12	29 250	601 538	6,974,788
	16.60	58.40	576,473	11,072 560	15 20 0	81 12 6	2,754 48	4,054 39	17,881 438
SHARKAWIYAH SYSTEM									
Drains 3 and 4	—	—	—	—	—	—	—	3,562 564	3,562,564
BAHR MALAH SYSTEM									
E and W. Abshan drains	—	—	—	—	—	1 0 18	32 159	—	32,159
Ganabiyah Tombana	—	—	—	—	—	—	—	34,745	34,745
E and W. Ganabiyahs of Bahr Malah	—	—	12,571	175,994	—	—	—	—	175,994
	—	—	12,571	175 99	—	1 0 18	32 15	34 74	242,898
FUAH SYSTEM									
Shabas El Malt drain (No. 10)	3.60	17.60	102,932	1,945 070	16 17 12	2 4 4	61 931	731 49	2,738,497
Fuah drain (No. 11)	—	4.20	14,950	—	—	—	—	—	—
	3.60	21.80	116,885	1,945,076	16 17 12	2 4 4	61 931	731 49	2,738,497
NASHART SYSTEM.									
Nashart drain	14.41	—	277,333	—	—	—	—	—	—
E and W. Ganabiyahs Sidi Salem	15.90	—	148,470	—	—	—	—	—	—
E and W. Ganabiyahs Khalig Ahman	4.78	—	39,784	—	—	—	—	—	—
E and W. Ganabiyahs Zenn	11.59	—	64,934	—	—	—	—	—	—
Feeder to Bahr Ibrahim	1.70	—	14,157	8,935,421	65 0 4	97 22 16	1,525 771	13,950 751	24,431,943
Raising banks of Bahrs Nashart, Ibrahim, and Khalig Ahman	—	—	98,542	—	—	—	—	—	—
Saddis Bahr Ibrahim	—	—	600	—	—	—	—	—	—
Extending Shaba and Ebru canals	10.80	—	19,552	—	—	—	—	—	—
Um Yusuf drain	4.90	24.57	651,177	9 767 597	—	128 8 2	4,089 282	2,953,839	16,810,716
	64.20	24.57	1,314,547	18,793 913	65 0 4	226 6 18	5,615 05	16,924 530	41,242,659
TOTALS.	84.40	104.77	2,020,472	31,896 610	97 13 10	310 23 22	8,463 628	25,307 788	65,668,656
MISCELLANEOUS WORKS.									
Land acquired previous to 1899	—	—	—	—	—	—	—	—	1,045,876
Boundary stones on all drains	—	—	—	—	—	—	—	—	1 373,360
Staff and General Expenses	—	—	—	—	—	—	—	—	2,591,668
									70,658,960

198,000 dredging. 1,827,472 hand work.

APPENDIX E.

DETAIL OF "EXPENDITURE ON WORKS" COLUMN OF PRECEDING TABLE.

NAME OF DRAIN OR IRRIGATION CHANNEL.	DESCRIPTION OF WORK	EXPENDITURE	TOTAL.
		£ E	£ E.
BAHR SHIBIN SYSTEM.			
Muhit drain	5 pipe syphons commenced in 1898, finished in 1899	674,391	1,002,591
	5 timber bridges commenced in 1898, finished in 1899	166,400	
	2 timber bridges constructed in 1899	161,800	
Batra drain	1 new pipe aqueduct and lengthening	728,623	823,501
	33 pipe aqueducts		
	3 new timber bridges and repairing	94,878	
Nawia drain	5 timber bridges	252,400	1,320,800
	23 pipe aqueducts	1,068,400	
Talkha drain.	2 timber bridges and 10 pipe aqueducts	305,963	305,963
Demillash drain	6 timber bridges	388,100	601,538
	4 new pipe aqueducts and lengthening	213,438	
	8 pipe aqueducts		
SHARKAWIYAH SYSTEM.			
Regulating heads.	Head sluice Bahr Maassara	1,193,776	3,562,564
	Head sluice Bahr Bishma	1,046,732	
	Head sluice Bahr Banawan	549,971	
	Beltrine syphon Sharkawiyah drain (part).	772,085	
BAHR MALLAH SYSTEM.			
Ganabiyah Tombara	Lengthening one pipe aqueduct	34,745	34,745
FUAH SYSTEM.			
Shabas El Malh drain (No. 10)	Erecting 6 pipe aqueducts and repairing	476,386	731,496
Fuah drain (No. 11).	4 pipe aqueducts	255,111	
	4 timber bridges		
Carried forward			8,383,198

DETAIL OF "EXPENDITURE ON WORKS" COLUMN OF PRECEDING TABLE (*continued.*)

NAME OF DRAIN OR IRRIGATION CHANNEL	DESCRIPTION OF WORK	EXPENDITURE	TOTAL.
		£E.	£E.
	<i>Brought forward</i> . . .		8,383,198
NASHART SYSTEM.			
	35 pipe aqueducts and syphons	1,839,915	
	Masonry for syphon on passing E. Sidi Salem Ganabiyah under Nashart drain and for Khalig Ahmar escape.	484,944	
	18 bridges on main drain & ganabiyahs.	1,001,500	
	22 irrigation culverts	125,300	
	Remodelling old Regulator Kalline. .	143,710	
Nashart drain.	Two head sluices for channels shifted to up- stream of new Kalline Regulator. .	366,416	
	Kafr Rabca Regulator and Lock (part). .	8,067,705	
	Revetment at Sidi Salem Regulator. .	139,988	
	Head sluices of Sidi Salem Ganabiyahs. (arrears)	43,012	
	Head sluices of Zeni Ghannabiyahs. (arrears)	55,350	
	Zeni Regulator and Lock (arrears) . .	155,316	
	Kalline Regulator (part)	1,547,595	
			13,970,751
Um Yusuf drain.	Ghonemi syphon (part)	1,450,000	
	12 timber bridges	951,000	
	10 pipe aqueducts	552,839	
	5 pipe aqueducts lengthened		
			2,953,839
	TOTAL		25,307,788

APPENDIX F.

ABSTRACT OF DRAINAGE WORKS EXECUTED IN 1899 IN 3RD CIRCLE.

NAME OF DRAIN	Length in kilometres		Earthwork, including dredging		Land			Expenditure on works.	Total Expenditure.
	New	Remodelled	Cube	Cost	Area given	Area purchased	Cost		
			C.M.	₹E.	FED.	FED.	₹E.	₹E.	₹E.
EDKU SYSTEM.									
Edku	—	12.2	283,159	8,380	—	—	—	381	8,761
Khairi	1.2	—	8,175	115	—	1.5	200	1,017	1,332
Khandak Gharbi	—	—	117,401	2,210	—	115	3,298	1,256	6,764
Shibrakhit	—	—	—	—	—	—	—	131	131
Kadr Hamayda	—	—	6,976	110	—	37	1,212	701	2,023
Minier Salama	—	7.0	116,026	1,947	—	17	493	1,382	3,822
Sarawella	—	8.0	69,103	1,106	—	1	22	471	1,599
MAREJIS SYSTEM.									
Umum	—	17.5	299,518	5,626	—	6.5	107	473	6,206
Shereishra	—	7.2	152,185	2,518	—	—	—	485	3,003
Beda	—	—	50,596	781	—	1	33	1,494	2,308
Abu Hommos	—	—	18,077	272	—	—	—	1,724	1,996
Dessunes	—	9.3	103,830	1,454	—	5.5	91	372	1,917
Mamel	—	1.5	9,850	138	7.0	—	—	11	149
Gabiars	—	—	—	—	—	—	—	245	245
Mex pumps	—	—	—	—	—	—	—	16,536	16,536
Miscellaneous Works.									
Regulator kilo. 26—Hager Canal	—	—	6,579	155	—	—	—	472	627
Drain bridges constructed jointly with Light Railway	—	—	—	—	—	—	—	590	590
Kilo. marks for drains	—	—	—	—	—	—	—	140	140
Land payments for lands occupied last year	—	—	—	—	—	102.5	2,611	—	2,611
Staff and sundries	—	—	—	—	—	—	—	—	1,393
Totals	1.2	62.7	1,241,475	24,812	7.0	287.0	8,067	27,881	65,153

262 8.90 dredging 978 645 hand-work

APPENDIX G.

DETAIL OF "EXPENDITURE ON WORKS" COLUMN OF APPENDIX B.

NAME OF DRAIN	DESCRIPTION OF WORK.	EXPENDITURE.	TOTAL.
		₹E	₹E.
Edku	1 bridge	381	381
Khairi	Share of Light Railway bridge . .	143	
	1 bridge	143	1,017
	5 inlet pipes	103	
	6 pipe aqueducts	232	
	Boundary stones kilo marks. . .	96	
Khandak Gharbi	1 masonry railway bridge . . .	900	1,256
	4 pipe aqueducts	272	
	5 outlet pipes	84	131
Shibrikhit	2 pipe aqueducts	131	
Kafr Hamayda	3 bridges	75	701
	21 pipe aqueducts	539	
	Share of Light Railway bridge . .	87	1,382
Miniet Salama	4 bridges	217	
	2 old bridges repaired	35	
	7 pipe aqueducts	171	
	1 syphon under Sahel Markas . .	959	
Sarawella	4 bridges	146	471
	4 pipe aqueducts	176	
	1 pipe syphon	149	473
Umum	2 bridges	218	
	1 pipe aqueduct	156	
	Boundary stones kilo marks. . .	99	
Shereishra	4 bridges	162	485
	2 pipe aqueducts	96	
	Share of Light Railway bridge . .	168	1,494
	Boundary stones etc.	59	
Beda	1 masonry culvert under railway .	1,410	1,494
	Boundary stones kilo marks, etc. .	84	
<i>Carried forward</i>		—	7,791

DETAIL OF "EXPENDITURE ON WORKS" COLUMN OF APPENDIX B.—*concluded.*

SHEET OF DRAWING	DESCRIPTION OF WORK	EXPENDITURE.	TOTAL
		£F	£E.
	<i>Brought forward</i>	—	7,791
Abu Hommos	2 masonry syphons under Fransawiyah and Mehaller Keil Canals . 1 iron and masonry culvert under the railway	1,089 635	1,724
Dessines	7 bridges 4 pipe aqueducts Boundary stones, etc.	175 88 109	372
Mamel	1 bridge	11	11
Gabaues	1 masonry syphon	245	245
Mex Pumps	Main works in connection with installation of three new Farcot pumps, masonry, ironwork, roofing, etc. Staff house Electric light Breakwater	15,000 1,150 125 261	16,536
Regulator on Hager Canal . .	1 regulator of 2 bays	172	472
4 bridges constructed jointly with Light Railway . . .	4 bridges	590	590
Kilo marks for drains . . .	Purchase of 425 kilo marks	140	140
	Total	—	27,881

ABSTRACT.

1 regulator of 2 bays	8 Light Railway bridges (shared)
3 large masonry syphons	25 road bridges
2 small " "	10 pipe culverts
2 large railway culverts	51 iron pipe aqueducts

Boundary stones, kilo marks, etc.
Enlargement of Mex Pumping Station.

APPENDIX II.

NILE GAUGES FOR THE YEAR 1899.

No.	JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
	Aswan		Barra		Barra		Barra		Barra		Barra		Barra		Barra		Barra		Barra		Barra		Barra	
	P.	K.	P.	K.	P.	K.	P.	K.	P.	K.	P.	K.	P.	K.	P.	K.	P.	K.	P.	K.	P.	K.	P.	K.
1	13.92	6	13.92	6	13.92	6	13.92	6	13.92	6	13.92	6	13.92	6	13.92	6	13.92	6	13.92	6	13.92	6	13.92	6
2	13.89	6	13.89	6	13.89	6	13.89	6	13.89	6	13.89	6	13.89	6	13.89	6	13.89	6	13.89	6	13.89	6	13.89	6
3	13.87	6	13.87	6	13.87	6	13.87	6	13.87	6	13.87	6	13.87	6	13.87	6	13.87	6	13.87	6	13.87	6	13.87	6
4	13.84	6	13.84	6	13.84	6	13.84	6	13.84	6	13.84	6	13.84	6	13.84	6	13.84	6	13.84	6	13.84	6	13.84	6
5	13.81	6	13.81	6	13.81	6	13.81	6	13.81	6	13.81	6	13.81	6	13.81	6	13.81	6	13.81	6	13.81	6	13.81	6
6	13.78	6	13.78	6	13.78	6	13.78	6	13.78	6	13.78	6	13.78	6	13.78	6	13.78	6	13.78	6	13.78	6	13.78	6
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15	13.51	6	13.51	6	13.51	6	13.51	6	13.51	6	13.51	6	13.51	6	13.51	6	13.51	6	13.51	6	13.51	6	13.51	6
16	13.48	6	13.48	6	13.48	6	13.48	6	13.48	6	13.48	6	13.48	6	13.48	6	13.48	6	13.48	6	13.48	6	13.48	6
17	13.45	6	13.45	6	13.45	6	13.45	6	13.45	6	13.45	6	13.45	6	13.45	6	13.45	6	13.45	6	13.45	6	13.45	6
18	13.42	6	13.42	6	13.42	6	13.42	6	13.42	6	13.42	6	13.42	6	13.42	6	13.42	6	13.42	6	13.42	6	13.42	6
19	13.39	6	13.39	6	13.39	6	13.39	6	13.39	6	13.39	6	13.39	6	13.39	6	13.39	6	13.39	6	13.39	6	13.39	6
20	13.36	6	13.36	6	13.36	6	13.36	6	13.36	6	13.36	6	13.36	6	13.36	6	13.36	6	13.36	6	13.36	6	13.36	6
21	13.33	6	13.33	6	13.33	6	13.33	6	13.33	6	13.33	6	13.33	6	13.33	6	13.33	6	13.33	6	13.33	6	13.33	6
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27	13.15	6	13.15	6	13.15	6	13.15	6	13.15	6	13.15	6	13.15	6	13.15	6	13.15	6	13.15	6	13.15	6	13.15	6
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29	13.09	6	13.09	6	13.09	6	13.09	6	13.09	6	13.09	6	13.09	6	13.09	6	13.09	6	13.09	6	13.09	6	13.09	6
30	13.06	6	13.06	6	13.06	6	13.06	6	13.06	6	13.06	6	13.06	6	13.06	6	13.06	6	13.06	6	13.06	6	13.06	6
31	13.03	6	13.03	6	13.03	6	13.03	6	13.03	6	13.03	6	13.03	6	13.03	6	13.03	6	13.03	6	13.03	6	13.03	6

P.K. = paces knots P.S. = upstream R.L.

APPENDIX K.

SHARAKI, 1899. — (*État provisoire.*)

Moudirias	Whole Sharaki			Half Sharaki.	Total.
	Uncultivated	Cultivated from wells.	Total		
	Fed.	Fed.	Fed.		Fed.
Assouan	19,041	3,096	22,137	12,358	34,495
Kena	79,254	22,965	102,219	33,074	135,293
Guerga	44,649	13,408	58,057	18,443	76,500
Assiout	23,502	1,275	24,777	10,204	34,981
Minia	13,979	6	13,985	4,321	18,306
Beni Souef	8,137	110	8,247	2,102	10,349
Guisa	28,904	2,563	31,476	6,720	38,187
Kallioubia	622	—	622	68	690
Dakahlia	193	—	193	11	204
Gharbia	70	—	70	17	87
Menoufia	2,026	—	2,026	867	2,893
Behera	1,110	—	1,110	349	1,459
TOTAL . . .	221,487	43,423	264,910	88,534	353,444

REPORT ON THE NILE RESERVOIR WORKS,

1899

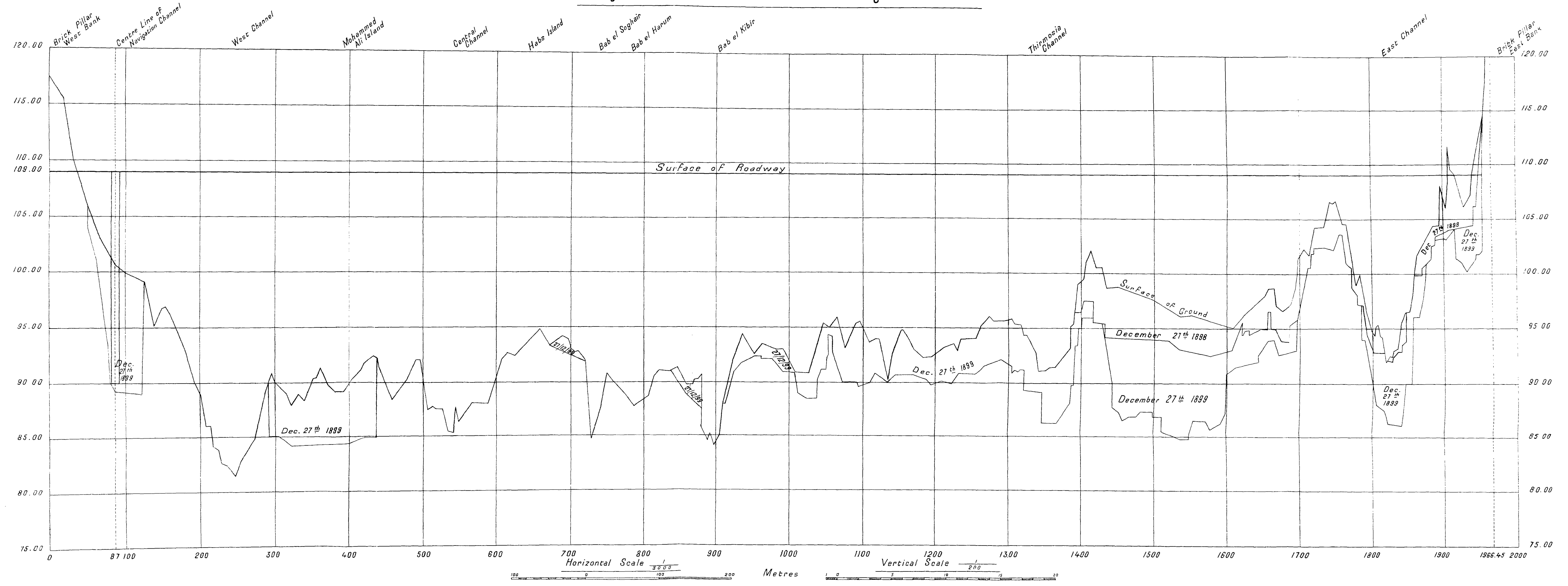
BY

W. J. WILSON,

DIRECTOR GENERAL OF RESERVOIRS

NILE RESERVOIR WORKS ASSUAN

Longitudinal Section of Dam shewing Excavation



REPORT ON THE NILE RESERVOIR WORKS, 1899.

1.—These works comprise a dam and navigation channel at Aswan, an open weir and lock in the river at Asyut, and a regulating bridge and lock at the head of the Ibrahimiya Canal. A history of the project and a general description of the works were given in last year's report and it is unnecessary to repeat them.

Messrs. John Aird & Co., of London, are the Contractors for constructing the works, and Messrs. Ransomes & Repier, Limited, of London and Ipswich, have undertaken to supply and erect the ironwork of the sluices and locks at Aswan.

The Aswan Dam.

2.—The preliminary works in connexion with the construction of ^{Work done in 1898} the dam were commenced in April, 1898, and during that year work was confined to excavation on the line of the dam and the navigation channel, and to bringing on to the ground the plant and materials required for dealing with the excavation and masonry on a large scale as soon as the flood should subside. A large number of houses, shops, restaurants, and hospital buildings were built, so as to provide for the supervising staff, workmen, and other persons indirectly connected with the works. Excavation was commenced on a length of 540 metres from the east end of the dam and the quantity excavated was 21,399 cubic metres.

3.—During the year excavation was completed in a length of ^{Excavation} about 685 metres from the east end of the dam and in a length of 55 metres in the Mohamed Ali island: it was in progress in other parts, aggregating 600 metres in length. The excavation has been carried down to solid rock and this has necessitated going considerably deeper than was originally anticipated. The total quantity of excavation done to the end of the year is 100,212 cubic metres. The accompanying section shows the excavation done during the two years.

Mr. Blue, the Contractors' agent, has furnished me with the following statement of explosives used for blasting purposes to the end of the year:—

Blasting Powder	28,000 lbs.
» Pellets	2,000 »
» Gelatine	100 »
Gelignite	89,950 »
Tenite	10,000 »
Detonators	380,000 No.
Patent safety Fuse	43,320 Coils.
Detonator Fuses	15,000 No.

Character of
the rock.

4.—The rock on which the dam is built is generally good granitic and dioritic rock traversed by lines of joints and faults in different directions. It varies very much in texture, being very fine grained in places and very coarse in others. In parts of the trench the rock is much crushed and can be removed with picks, and this has necessitated the extra excavation in some places 8 metres in depth—noted above. Here the rock is mostly a decomposed schist and in places no more than clay. A geological survey of the trench has been made by Dr. Ball of the Geological Survey, and a report with maps and sections will shortly be published. Specimens of the different kinds of rock were sent to Sir Benjamin Baker in London, and were shown by him to Sir Archibald Geikie. The latter states that the disintegration is due to percolating water finding its way along the lines of joints, and that it must have been a very slow process going on from the time when the climatic conditions may have been widely different from what they are now.

Masonry.

5.—The foundation stone of the dam was laid on February 12th, 1899, by H. R. H. The Duke of Connaught. Masonry was commenced on March 16th, but very little progress was made before the beginning of April. During that and the following three months, work was energetically carried on in a length of 620 metres on the east bank; and a length of 540 metres was raised to a sufficient height to allow of the work being continued during the flood. A commencement was made with masonry in the Mohammed Ali island but, owing to the delay experienced in getting to sound rock, very little work was done. The position and height of the masonry laid is shown on the accompanying section. The dam has been built to R.L. 107 or 2 metres below roadway level in a length of 360 metres, and to R.L. 105·5 in

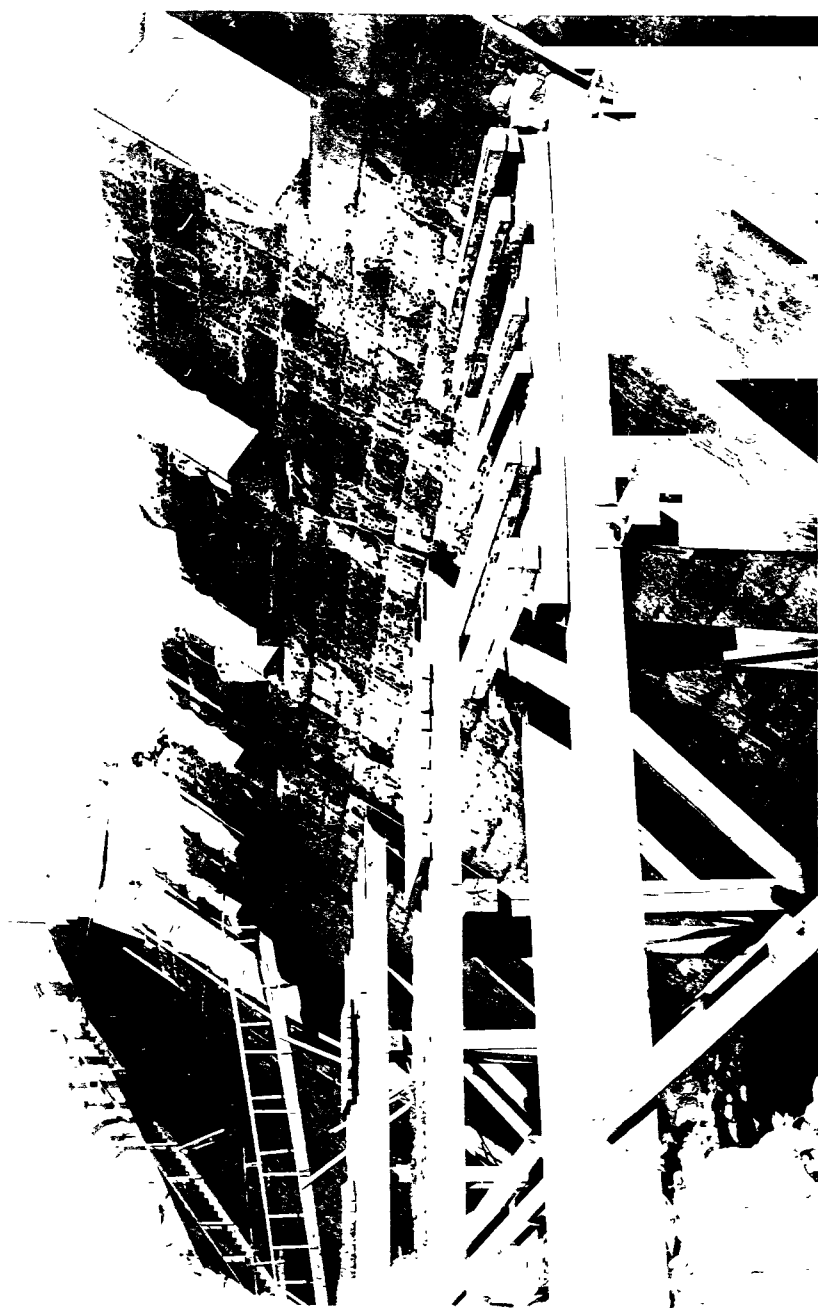


FIGURE 1. VIEW OF HIGH LEAF STRUCTURES (DOWNSTREAM)

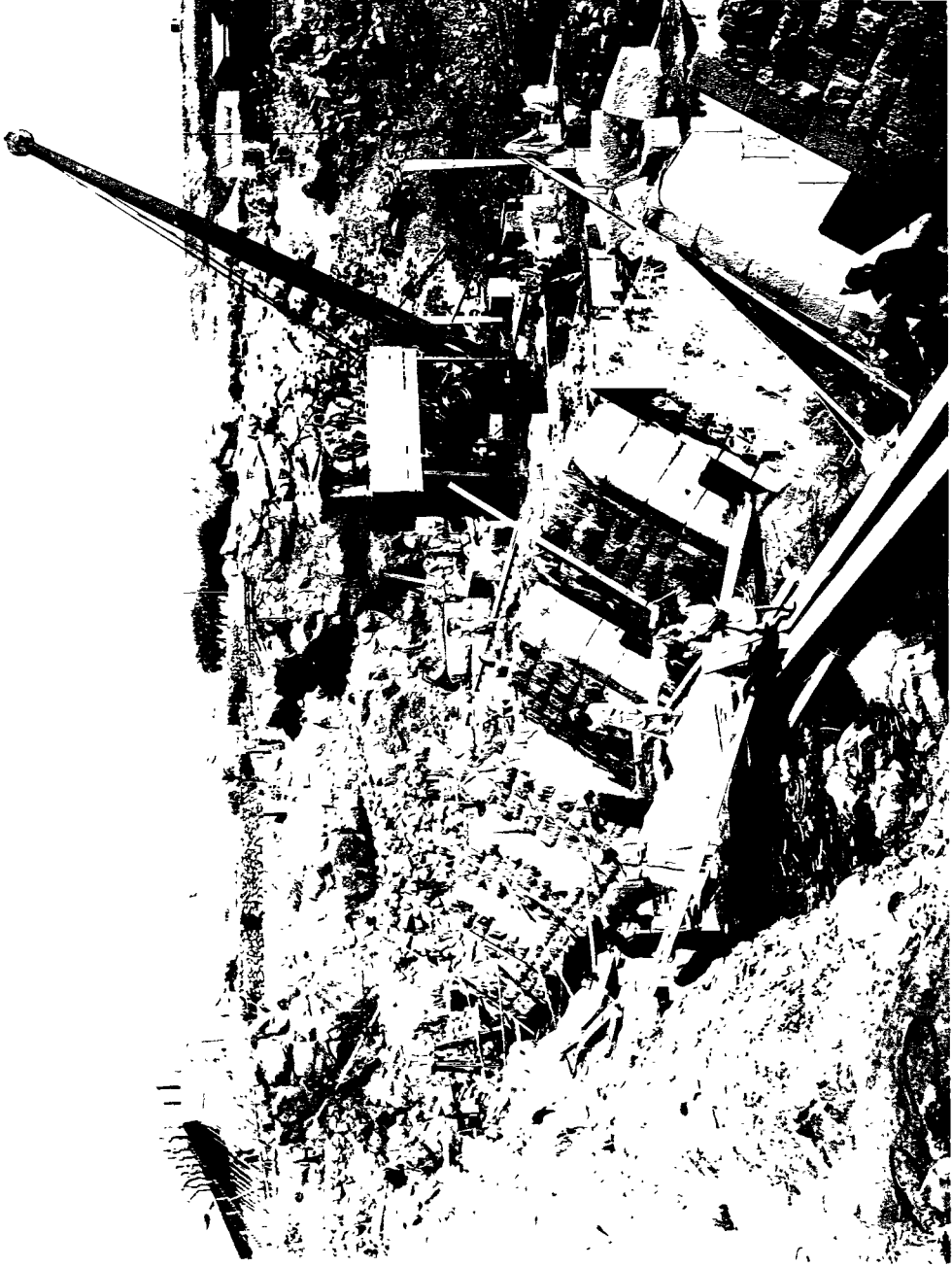


PLATE VI.—VIEW OF SLUICES FROM DOWNSTREAM.

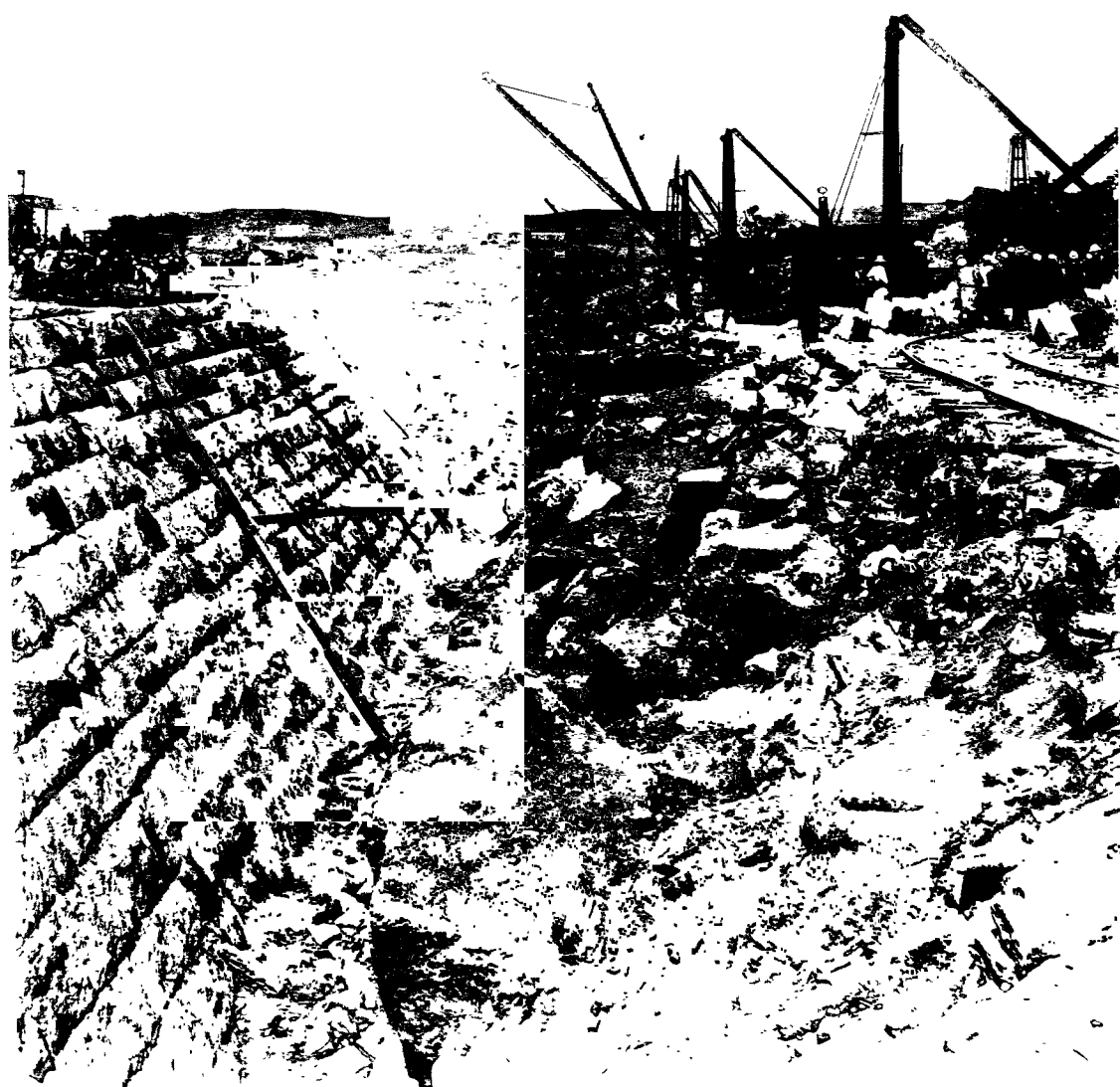


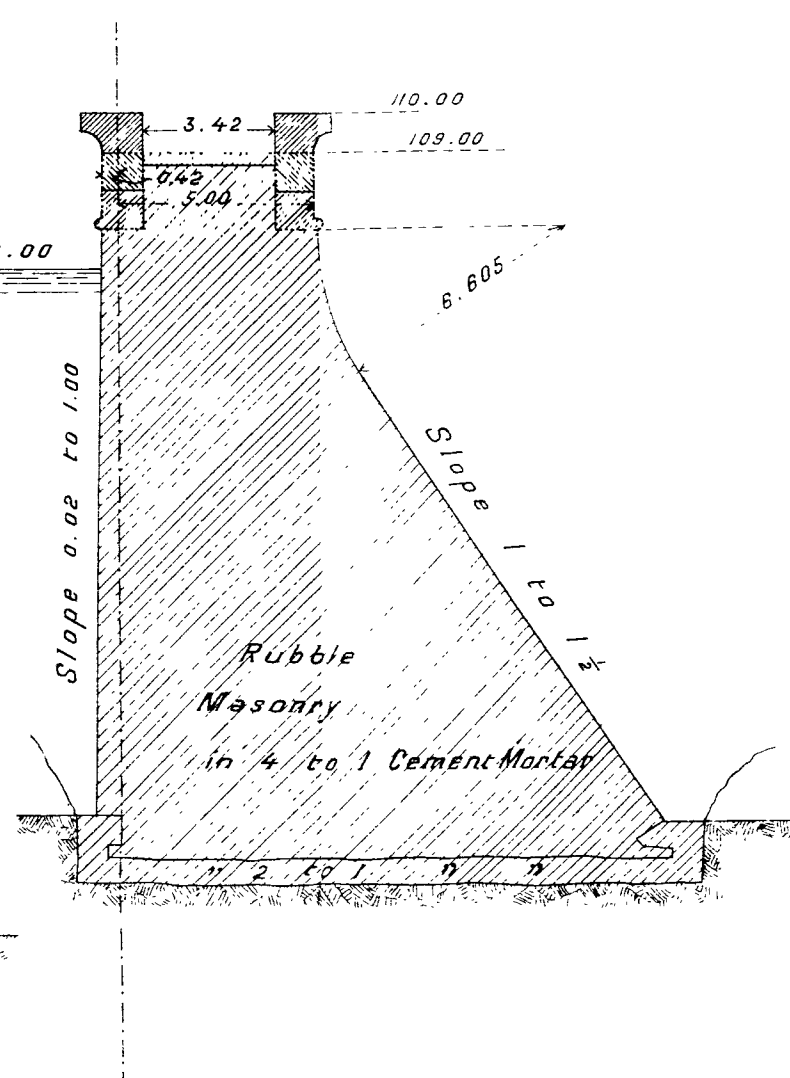
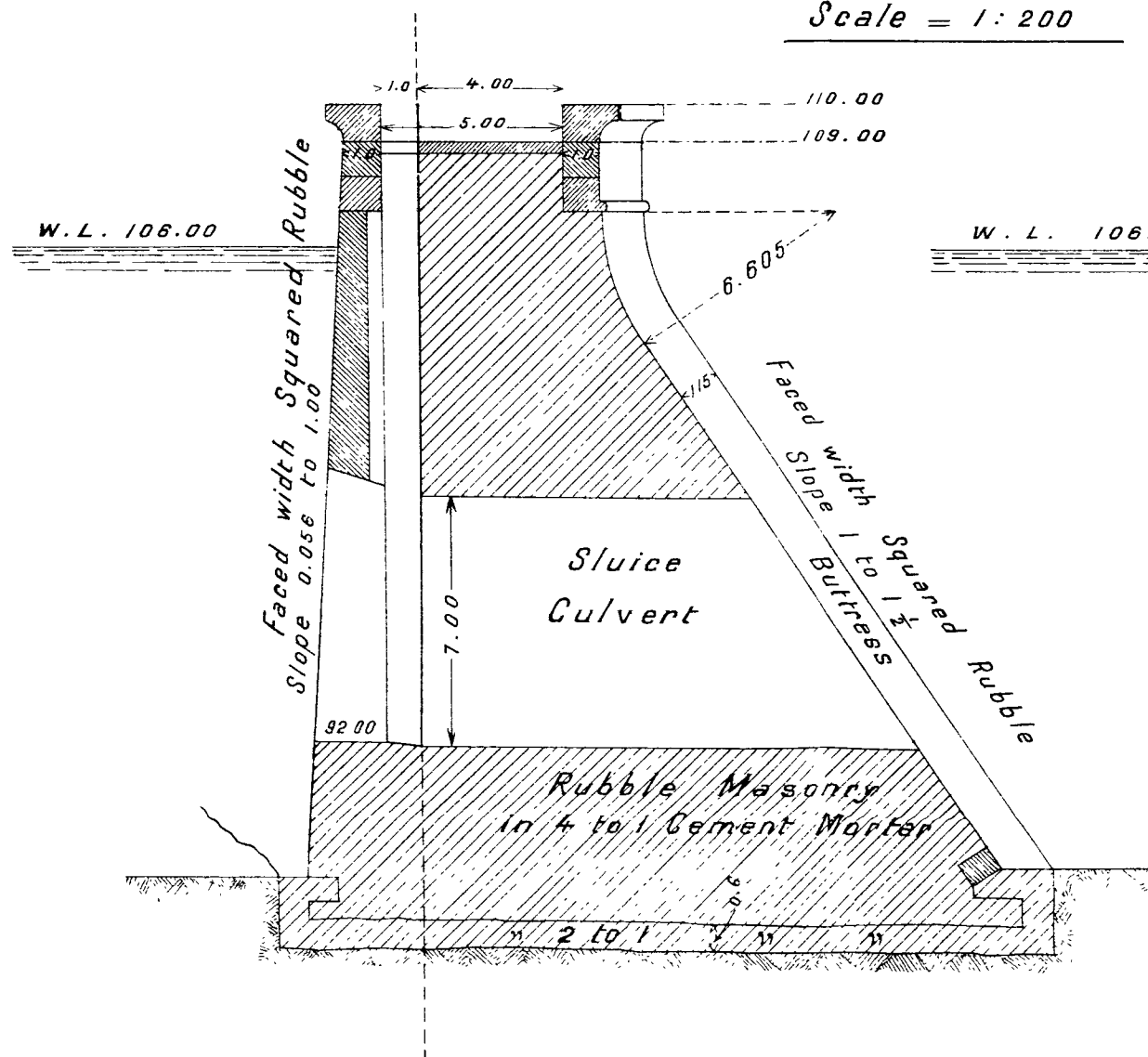
PLATE VII.—EAST FLANK OF DAM (DOWNSTREAM).

GROSS SECTIONS OF DAM

Section of Pierced
Dam

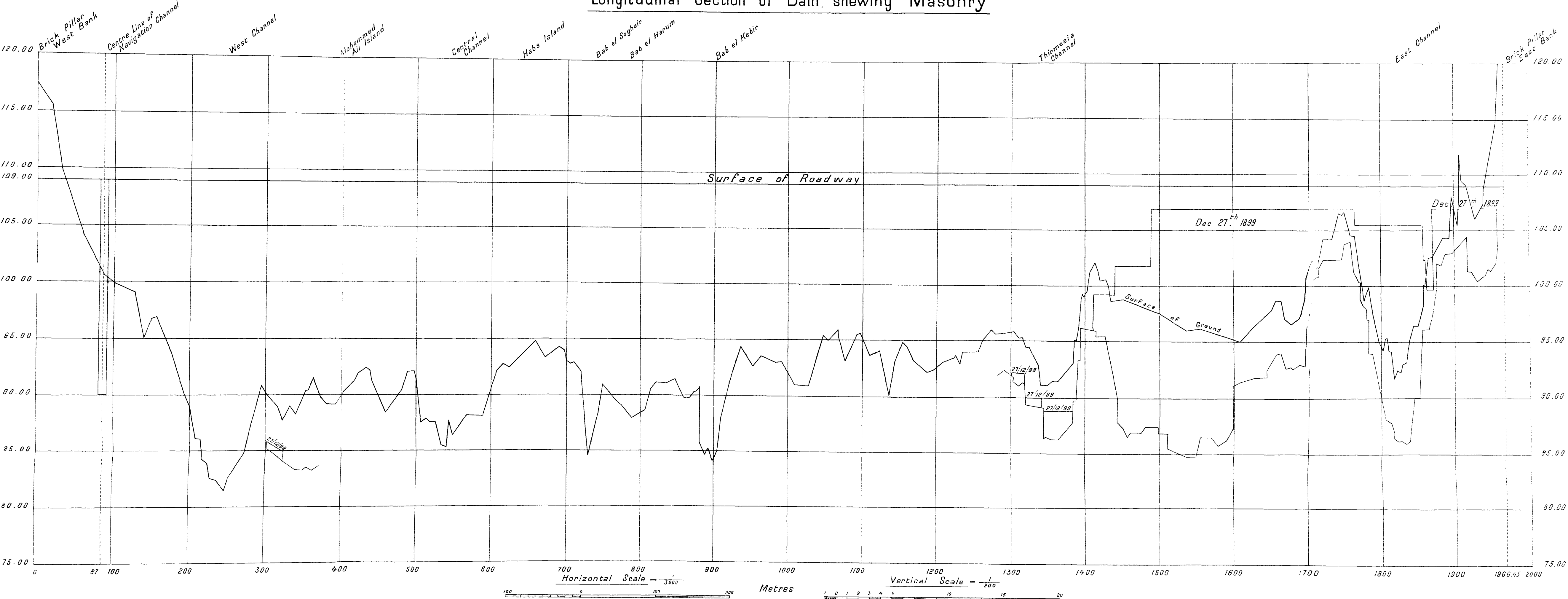
Section of Solid
Dam

Scale = 1 : 200



NILE RESERVOIR WORKS ASSUAN

Longitudinal Section of Dam, shewing Masonry



a further length of 90 metres. This portion of the dam is solid; the rest will have sluices in it for passing the discharge of the river.

The quantity of masonry executed to the end of July was 42,171 cubic metres, the maximum in one month being 16,094 cubic metres in July. The total quantity laid during the year was 74,703 cubic metres.

The masonry is uncoursed rubble in the interior of the dam with roughly squared rubble on the two faces. It is laid in cement mortar; that in the face-work and within 65 centimetres of the living rock being made of two parts of sand to one cement, and the rest of four parts of sand to one of cement.

6.—The most interesting work carried on during the year was the construction of "saddles" or temporary dams across three out of the five deep channels of the river, which cross the line of the dam and carry the supply of the Nile in the winter and summer. These channels are known as the Bab-el-Kebir, Bab-el-Haroun, and Bab-el-Sughaiyar, and the fall through them from about 100 metres above to an equal distance below the axis of the dam was about 3 metres at low Nile. These are the first rapids of the Aswan Cataract, and the total fall in the river from Philae to Aswan was about 5 metres before the regime of the river was disturbed by the construction of these works.

Before the dam can be built across these channels it is necessary to construct temporary dams up and downstream of the site sufficiently watertight to allow of the area between them being laid dry by pumping.

These dams are most easily made of bags filled with coarse sand, but before they could be commenced it was necessary to throw stone "saddles" across the channels so as to reduce the volume of water flowing down them, and it was found most convenient and economical to make these saddles downstream of the site. They were kept sufficiently far from the foundation pit to allow of sand-bag saddles being made between them and the dam if it was found necessary to do so.

It was decided to make the stone saddles before the flood, so as to allow of the sand-bag saddles being commenced as soon as the flood should subside. In the old condition of the river before the saddles were commenced the mean low water level in the river upstream of the site of the dam was R.L. 90.0 and the mean high flood level was R.L. 98.6. The stone saddles were made up to R.L. 93.0 or 5 metres below ordinary flood level. They were made of large stones weighing from one to four tons with small stones to fill up the spaces between them. Wire

nets or "Shimfs," filled with small stones and weighing from one to four tons were also used, but were not so successful as had been expected, as the wires were frequently cut by the sharp edges of the stones and the stones fell out. The large stones and "shimfs" were put into place by a crane working on the end of the sadd; the smaller stones were tipped from wagons. Above water level and on the downstream slopes the stones were carefully packed and rails were built into the slopes and crests of the sadds to keep the stones together.

The three channels are close together and the sadds across them formed practically one continuous sadd. They were constructed from the east side and the first stone was put into the Bab-el-Kebir on March 13th. This channel was successfully closed on the 17th May under a head of about 2 metres; before it was closed the current became so strong that stones a couple of tons in weight were frequently carried downstream. The length of this sadd was 60 metres, greatest depth 19 metres, width at top about 9 metres, downstream slope one to one and upstream slope three-fourths to one. The quantity of stone used in it was 15,000 cubic metres. The width at top was sufficient to allow of rails being laid and wagons run to supply materials for the other sadds.

The sadd was then continued across the Bab-el-Haroun, a channel about 50 metres wide, and much shallower than the Bab-el-Kebir. It was closed without difficulty on June 12th, and, as the current was not strong, comparatively small stones were used in it.

The closing of the Bab-el-Sughaiyar was then taken in hand. This channel is only 35 metres wide, but it was about 8.5 metres deep throughout. Owing to the discharge down the Bab-el-Kebir and Bab-el-Haroun having been reduced to the quantity of water leaking through the sadds, and the consequent heading up of the water upstream while the downstream level had been reduced, the rush of water through the Bab-el-Sughaiyar was very strong, and increased as the channel was narrowed. Stones of three and four tons in weight were carried away and for some days no progress was visible. On a suggestion of Mr. Fitzmaurice, two large railway wagons were loaded with wire nets filled with stones, each net weighing from two to three tons; the nets were then wired together and secured to the wagons by steel ropes passed over the nets and under the wagons, rails were laid to the end of the sadds, and the two wagons, each weighing about twenty-five tons, were run bodily into the current. They were heavy enough to stand the force of the water, and formed a toe against which other stones were stopped. The sadd was closed on the 11th July.



PLATE VIII.—CONSTRUCTION OF STONE “NADDI”.

The closing of the three channels raised the upstream level of the river a little over one metre. The head on the saddls was 3.74 metres.

By the 16th July the river had risen to the level of the top of the saddls (R.L. 93.6). On the 22nd the saddl on the Bab-el-Haroun was breached and nearly all of it was carried away. At the time of the breach the head of water on the saddl was 3.15 metres, and this was reduced to 2.84 metres immediately after the breach. The breach was probably caused by a slip on the downstream side. As previously mentioned, comparatively small stones were used in this saddl and they were apparently not large enough to withstand the flow of water over them.

The highest gauge recorded at Aswan was R.L. 91.66 on the 5th of September, the mean high flood level being R.L. 92.90. Owing to the low flood work was recommenced on the 11th November, and on the 6th December the Bab-el-Haroun was finally closed.

The quantity of stone used in the three saddls was about 45,000 metres.

7.—The sand-bag saddl across the Bab-el-Kebir to the south of the site of the dam was commenced on the 7th November, and the three channels were closed on the 4th January, 1900. Some days were spent in staunching the saddls by throwing sand on the upstream slopes so that it might be drawn into the interstices of the saddls.

Six 12-inch centrifugal pumps were started in the Bab-el-Kebir on the 9th January and the channel was dried by 10 o'clock that night. After that two 12-inch pumps were required to deal with the leakage for some days, but as the leaks were gradually closed by sand one 12-inch centrifugal and a 4-inch plunger pump proved sufficient to deal with the water.

In the Bab-el-Haroun only one 4-inch pump is required, and in the Bab-el-Soghayyar two pumps of that size are able to deal with the leakage.

It is to be noted that very little water comes through the sand-bag saddls, the chief leaks being at the ends of the saddls, where the water probably finds its way between boulders.

When the saddls were started the upstream water level was R.L. 93.00 and the level downstream of the stone saddls was R.L. 90.0. After the saddls were completed these levels became R.L. 92.04 and 80.30 respectively. A very small saddl on the downstream side was sufficient to prevent any water getting back into the trench.

The materials used in the sand-bag sadds were as follows :—

Stone	7,884 cubic metres
Sand and earth	24,894 ..
Sacks	374,369 ..

The low river was most favourable for the construction of sadds as, if the river had been at its ordinary level, they could not have been started so soon and the outlay upon them would have been greater.

Permanent
work.

8.—The quantities of permanent work executed to the end of the year are shown below :—

KIND OF WORK	QUANTITY EXECUTED IN		TOTAL.
	1898	1899	
	C.M.	C.M.	C.M.
Excavation	21,399	78,813	100,212
Rubble masonry	—	74,703	74,703
Ashlar	—	160	160

The value of the above work is £,237,284.

Ironwork

9.—Messrs. Ransomes and Rapier, Limited, have despatched to Aswan a considerable quantity of cast-iron plates for lining some of the sluices. Difficulty has been experienced in getting the large castings required for the cills, but I understand that this work is well in hand.

Navigation Channel and Locks.

Permanent
work.

10.—On the navigation channel and locks, work was confined to excavation, making up the bank on the river side, and pitching the slopes of the channel and bank with stone. About 300 metres in length of the channel to the south of the dam has been excavated to the full width and depth.

The quantities executed to the end of the year are shown below :—

KIND OF WORK	QUANTITY EXECUTED IN		TOTAL.
	1898	1899	
	C.M.	C.M.	C.M.
Earth excavation	117,592	43,585	161,177
Rock excavation	1,610	105,665	107,275
Pitching	310	13,283	13,603

The value of this work is £,56,677.

ASYUT WEIR AND LOCK.

11.—The highest flood level at Asyut is R.L. 53.95 and the lowest summer level is R.L. 44.50. The river is highest in the latter half of September or early in October, and lowest at the end of May or beginning of June. The floors of the weir and lock are at R.L. 43.25, or 1.25 metres below lowest water level.

Design of the weir and lock.

In the original design rectangular wells, respectively 5 and 4 metres deep below floor level, were provided up and downstream of the weir, and the floor between the wells was two metres thick of concrete covered with ashlar and brickwork. There were round wells under the piers and walls of locks and abutment.

The system of enclosing the floor with masonry wells to form a cofferdam, though very extensively used in India, does not appear suitable to this country. In the first place it is not a system known to the Egyptians, while in the part of India with which I am acquainted every village has its well-sinkers. With the improved plant now used for the purpose in England wells could have been sunk, but a great deal of plant would have been required to sink the wells in the original design, numbering nearly 1,000, in a reasonable time.

It is to be noted, too, that the conditions of the Nile vary very considerably from those of the snow-fed Indian rivers. The latter are in flood from the latter part of June to September; after the rains cease they fall rapidly, and they are lowest in the cold weather when the snow melts slowly; they then rise gradually as the increasing heat melts the snow. The Nile falls rapidly after the flood till the end of December; the fall then decreases in rapidity, but it continues at Asyut till the end of May or beginning of June, after which the river begins to rise. This is shown by the following statement giving the discharge of the river at Asyut in an average year:—

DATE.	Discharge in cubic metres per second.
January 1st	1,940
February 1st	1,430
March 1st	1,040
April 1st	710
May 1st	530
June 1st	410
July 1st	670
August 1st	3,260

The conditions of the Indian rivers are favourable for an early commencement of the work, as the saddls can be made in November and December, and can be maintained against the rising river until the flood comes down in June. In the Nile the saddls have to be made under much less favourable conditions, as even on the 1st March the average discharge of the river is over a thousand cubic metres a second. One cannot count, therefore, on so long a working season, from the time the saddls are finished till work is stopped by the flood, on the Nile, as we can on the Indian rivers.

Sir Benjamin Baker, Consulting Engineer to the Egyptian Government, proposed to drive sheet-piling of cast-iron up and downstream of the weir, round the lock, and in front of the wing walls, and this system has been adopted; there is no doubt that the work has been carried out much more rapidly than it would have been with wells. The floor is of concrete 0·9 metre thick covered with masonry 2·1 metres thick, or 3 metres thick altogether. The piles are driven 4 metres below the bottom of the floor.

The weir has 111 bays of 5 metres in width; the piers are 2 metres thick, and there are twelve abutment piers 4 metres thick. The lock is 80 metres long and 60 metres wide.

The total lengths between the face of the lock wall on the west and the face of the wing wall on the east is 821·2 metres.

A cross section of the weir is attached.

Condition of
the river.

12.—The flood of 1898 was both high and late, and the river remained above its average level till the following June. From the 20th January to the 20th March 1899, the level at Asyut was higher than had previously been recorded since the gauge was fixed in 1889.

Notwithstanding the high water level, however, the conditions of the river were very favourable for commencing work, as the main channel of the river was near the east bank, and there was only a small channel on the west bank; between the two channels there was a wide sand-bank. The lock is on the west side, so temporary dams, of saddls, thrown across the western channel, allowed of the foundations of the lock and part of the weir being unwatered and excavated, while the foundations of the weir could be continued to near the outer edge of the sand-bank without making any more saddls.

Had sufficient materials and plant been at hand, work could have been started also on the east bank, and the abutment and about 120 metres in length of the weir could have been built with very little expenditure on saddls; but for reasons given later it was found necessary to confine work to the west bank.

The site of the weir had been tentatively set out before the flood, but it was necessary to change it owing to deep holes having been scoured in the western channel on the site first fixed.

13.—There is a long stone spur on the down-stream side of the saddle-head of the Ibrahimia Canal, and it was decided to make the first saddle across the western channel so as to close on to this spur. There is a great deal of stone in the bed of the channel at the end of the spur, and this prevented the bed being eroded and deepened as the channel was narrowed. This saddle was commenced on the 1st December 1898, when the Asyut gauge recorded 18.98, and was completed by the 24th idem. It was commenced from the island side of the channel, and a considerable length of it was made of earth with very little protection: as the width of the channel was reduced, it was necessary to use sand-bags and stone. The saddle, which was 135 metres long, was not watertight, but it stopped the flow of the water sufficiently to allow of other saddles being thrown across the channel immediately up and downstream of the site of the lock and weir. The latter saddles were made of earth obtained from the island and of sand-bags. These saddles were commenced on the 2nd January and completed on the 15th February 1899.

The materials used in the first saddle that was closed on to the stone spur were as follows:—

Stone	5,417 cubic metres.
Earth	6,015 ..
Bags	77,000 ..
Nets or shunfs	1,940 ..

The quantities in the saddles enclosing the side of the lock were:—

Earth	53,405 cubic metres.
Bags	48,532 ..

14.—Pumping was commenced on the 19th February when the Unwatering gauge recorded 17.47. Two 12-inch and four 8-inch centrifugals were at first worked, and another 12-inch pump was started on the 3rd April. They were erected on a staging close to the west bank, south of the lock, where the channel was deep. It was, however, difficult to keep the pump clear owing to it being so close to the bank, and eight wells were afterwards sunk at different places up and downstream of the foundations, and the pumps were erected on them. Six of the wells were 2 metres, and two were 1.5 metres in diameter. They were sunk to R.L. 38.5 and were plugged with sand concrete: three of sand and one of cement deposited in skips—the plugs were 0.7 metre thick.

The seven pumps noted above are equivalent to 4·7 twelve-inch pumps, and they lower the water in the foundation pit 4·5 metres below the river level. This was sufficient to allow of the excavation and pile driving to be proceeded with, but the water level in the pit was not lowered below 42·5, or 0·90 metre above the level of the top of the concrete.

Between the 22nd April and the end of May two 12-inch and two 10-inch pumps were got to work. The pumping power was then equivalent to eight 12-inch pumps, and the water level in the pit was kept from 25 to 40 centimetres below the tops of the pile. Three 6-inch pumps were fixed to unwater the trench between the piles, and concrete was commenced.

As the area of the pit increased by excavation in the sand-bank on the line of the weir, further pumping power was found necessary. Three 12-inch pumps were started between 19th and 24th May, bringing up the total power to eleven 12-inch pumps. This is the greatest power that was employed at any one time. The total area of the pit was then about 43,600 square metres, and the area of concrete laid was 5,450 square metres. The level of the water in the pit was 4·8 metres below that of the river.

In June the removal of the pumps near the west bank was commenced, and this was continued as the masonry works and pitching at this end progressed.

Work was somewhat delayed by the late arrival of some of the pumps ordered by the Contractors in England, and an 18-inch centrifugal reached the works too late to be erected. The centrifugals worked by vertical direct acting engines are the most suitable for this kind of work. They are easily handled, and two of them can be erected on a 2-metre well. 6-inch and 8-inch pumps are suitable for unwatering the trench between the piles.

Sheet-piling.

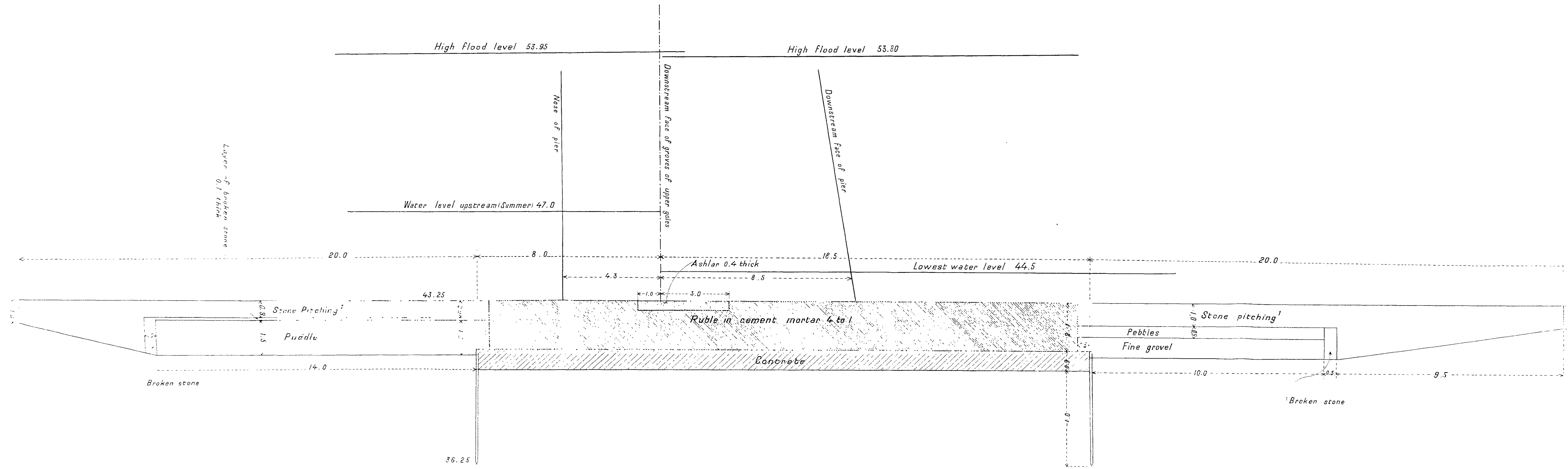
15.—Sheet piling of timber was driven behind the lock-wall. It was started on the 2nd March and completed on the 14th April. The total length was 210 metres. The piles were 8 metres long and about 16 centimetres thick, being made by cutting whole balks of timber in two. Two half balks were bolted together to form a pile about 60 centimetres wide. They were driven by steam pile engines working monkeys one ton in weight, and one engine drove three to four piles a day.

The cast-iron piles are very similar to some that have been used by Sir Alexander Rendel. They are tongued and grooved, but the

ASYUT WEIR

Cross Section of Weir

Scale $\frac{1}{100}$



grooves are $1\frac{1}{8}$ -inch longer than the tongues which are $1\frac{1}{8}$ -inch thick. Hence, if two piles are driven properly in contact, there is a space $1\frac{1}{8}$ -inch square at the end of the grooves, and this gets filled with sand. The sand is removed by water pumping down a $\frac{1}{2}$ -inch pipe which sinks into the grooves as the sand comes out. When the pipe reaches the bottom of the pile the pump is detached and cement grout is poured down the pipe. The cement when it sets makes a tight joint. This important modification in the design of the piles was due to Sir Benjamin Baker.

The dimensions of the piles are shown in the accompanying tracing. They were made in two lengths attached by wrought-iron cover plates. The lower length is 16 feet and is driven till its top is level with the top of the concrete. The upper length of 10 feet enables the lower piles to be driven before the excavation is completed to concrete level, and is afterwards removed.

The iron piles were driven by the same engines that drove the timber piles. To expedite the work they were driven in two stages, the forward engine driving them half way and the following engine doing the rest. When the pile-driving was started from the level of the top of the concrete, and the dummy length was not used, two engines could drive seven piles in a day, and eleven working night and day.

The driving of the iron piles was commenced on the 18th March and finished on the 15th June, but there was an interval in which delay occurred owing to want of piles. Some six feet bottom lengths were cast in the Government Arsenal and in other workshops in Egypt, in order to utilize some of the top 10-foot lengths that were to spare.

The grouting of the joints is kept 10 metres back from the piles that are being driven, as it is found that the driving shakes the piles to that distance.

16.—Concrete was started on the 4th May and masonry on the 7th idem. It had been intended to make the floor above the concrete partly of rubble stone and partly of brickwork, but the bricks first burnt turned out badly, so it was necessary to use rubble stone throughout. An excellent stone for building is obtained at Isawiya, about 120 kilometres up the river, and this was used for the floor. Some other stone obtained from Abu Fodah was used in the interior of the piers and walls. The concrete and masonry of the floor is in cement mortar. In the walls and piers above floor level the mortar is of lime and homra.

The foundations of the lock and of 210 metres in length of the weir

Permanent
work executed.

were completed. The area covered by the finished part of the foundations is 9,969 square metres, or 35 per cent. of the whole. The lock walls and twenty-three of the piers of the weir were raised from 2.5 to 4.6 metres above the floor. In cubic contents the masonry and concrete executed represents about one-fourth of the whole. During the first fifteen days of June the average quantity of concrete and masonry laid daily was 608 cubic metres.

The quantity of work executed before the flood was as follows:—

KIND OF WORK.	Quantity in cubic metres.
Earthwork in excavation and filling	361.735
Concrete	10.561
Rubble masonry in cement mortar	17.973
Rubble masonry in lime and honra mortar	7.541
Ashlar	663
Puddle upstream of weir	7.238
Gravel filter-bed downstream of weir.	1.857
Stone pitching	21.211

In addition to the above the cast-iron cills and lowest lengths of quoins were fixed for the downstream gates of the lock, and the lower lengths of grooves were fixed in the 23 piers. Culverts were built in the lock walls for filling and emptying the lock.

Springs.

17.—When the foundation pit was unwatered the top layer of soil was sludge or loose mud, about half a metre thick. Below this good clean sand was found and it was on this sand that the concrete was laid. A few powerful springs developed and were taken up through the floor in pipes; additional lengths of pipe were added so that the tops of the pipes were about 7 metres above the floor. The sadds were cut on the 7th August when the water in the river was at R.L. 48.37, and after the water over the floor had reached the level in the channel of the river, cement grout was poured down the pipes to fill the cavities below the floor caused by the removal of sand by the springs. 150 casks of cement were used in this work. The pipes, which had been partly filed through at floor level, were broken off after the cement had set.

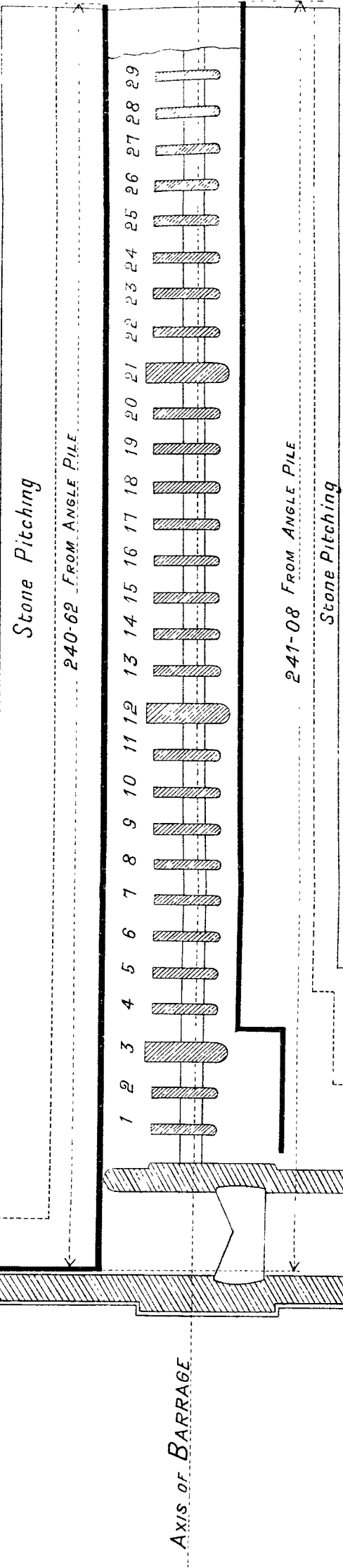
Protection of
end of floor

18.—To protect the end of the season's work in the event of the deep channel of the river changing and going over it, the end fifteen piles up and downstream were made longer than the others; additional

ASYÛT WEIR AND LOCK

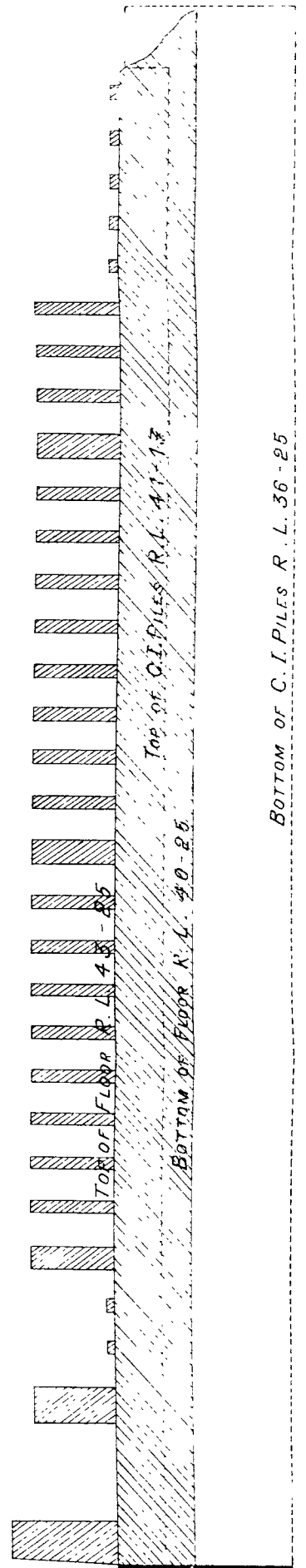
PLAN SHOWING WORK DONE IN SEASON 1898-99

SCALE = $\frac{1}{1000}$



River

WALADIEH CANAL



SECTION SCALES

HORIZONTAL = $\frac{1}{1000}$

VERTICAL = $\frac{1}{200}$

lengths of 16 feet were bolted on the lower lengths, and the combined pile of 32 feet in length was driven 3 metres deeper than the other piles. The tops of these long piles were then 20 c.m. below the level of the top of the floor, and the trench between the piles beyond the concrete was filled with sand-bags to the level of the tops of the piles. Mattresses of sand-bags roped together were continued beyond the piles and both up and downstream of them. As it happened, the sand-bank widened out towards the east during the flood and the end of the floor was covered with silt, so this protection proved unnecessary.

19.—As previously mentioned, the condition of the river was very favourable for putting in the foundations of the east abutment and the adjoining 120 metres in length of the weir. Owing, however, to delay in the arrival of pumps and to shortness of materials, it was decided not to attempt this. Work was confined to sinking two wells which would be ready for the erection of pumps in the following season. Work on the east bank.

20.—The highest level reached by the flood was 50.64 on the 6th and 7th September. By the 1st November the river had fallen to R.L. 48.47, by the 1st December to 47.35, and by 31st December to 46.58 respectively, 2.23, 1.63, and 1.68 metres lower than the corresponding levels of the preceding year. Work after the flood.

Excavation was started in the sand-bank over the end of last year's work on the 9th December, and by the 9th January 1900, sadds about 110 metres long had been thrown out from the sand-bank up and downstream of the weir, and had been joined by a sadd parallel with the stream. These sadds were made with the earth excavated to get in the foundations, and gave little difficulty, the velocity of water being slight. Two wells were sunk and pumps were erected on them, and on the two wells at the end of last year's work.

On the east side the conditions were less favorable than the previous year, considerable scour having occurred. On the 7th December a sadd was started from the east bank, and by the 10th January the sadds up and downstream and a sadd connecting them had been completed. This should enable the foundations of the east abutment and of about 110 metres in length of the weir to be got in. Four pumps were fixed on the two wells sunk before the flood.

Masonry was commenced on the west wall of the lock on the 26th December.

Altogether the conditions of the river are most promising for the progress of the work.

ESTABLISHMENT.

At Aswan.

21.—Mr. Fitzmaurice is the Resident Engineer of the Aswan Dam, and his Chief Assistants are Mr. C. May, who joined his post on the 19th October 1899, and Mr. Macdonald. At the end of the year fourteen other Engineers and Inspectors were employed on behalf of Government.

Mr. John Blue is General Manager for the Contractors and resides chiefly at Aswan. Mr. Bakwell is their principal Engineer at Aswan, and there are nine other Engineers and a large number of inspectors, mechanics, clerks, etc., on their staff.

At Asyut

22.—Mr. G. H. Stephens is the Resident Engineer at Asyut: Mr. Hood is his Chief Assistant, and at the end of the year there were four other Assistant Engineers on the Government staff, including Messrs A. Hurley and P. R. Boxwell, transferred temporarily from the Irrigation Department.

Mr. Pettit was the Contractors' Agent up to the flood. He was replaced after the flood by Mr. McClure. There are five Assistant Engineers and a number of inspectors, foremen, clerks, etc. on the Contractors' staff.

Sir Benjamin Baker spent four weeks inspecting the works at the beginning of the year, and three weeks again in November and December. He was accompanied on each visit by Mr. John Aird, M. P., and Mr. John Aird, Junior.

The average number of men employed at Aswan was about 6,000 of whom 800 were Europeans and 70 Englishmen. The greater number of the Europeans are Italian stone-cutters. The greatest number of men employed in any month was about 8,000 in June.

On the Asyut works as many as 10,000 men were employed when the earthwork was being pushed on.

W. J. WILSON.

APPENDIX

STATEMENT SHOWING THE EXPENDITURE ON RESERVOIR WORKS TO END OF 1899

	EXPENDITURE IN		
	1898	1899	Total
	£	£	£
Permanent work, Aswan Dam	20,886	273,075	293,961
Retention under Clause 39 of Specification .	3,132	29,264	32,396
Payment on account of permanent work . .	17,754	243,811	261,565
Advanced on preliminary works, Aswan Dam.	20,729	72,746	93,475
.. plant	31,040	53,545	84,585
.. materials	25,376	142,813	168,189
.. to Messrs Ransomes & Rapier .	—	55,972	55,972
Total payment on account of Aswan Dam .	94,899	568,887	663,786
Advanced on account of Asyut Weir and Lock.	16,024	274,917	320,941
.. .. payment for land .	23,400	12,100	35,500
.. .. import duties . .	8,400	18,900	27,300
Subsidiary works	3,934	8,731	12,665
Total . . . £	176,357	883,535	1,059,892

REPORT ON THE TANZIM DEPARTMENT.

1899.

BY

A. H. PERRY.

REPORT OF THE TANZIM DEPARTMENT FOR 1899.

UNDER SECRETARY OF STATE

I have the honour to submit a Report on the operations of the Tanzim Department in 1899.

The following services are treated separately :—

- (1) Special Works, Lower Egypt.
- (2) Special Works, Upper Egypt.
- (3) Inspection, Lower Egypt.
- (4) Inspection, Upper Egypt.
- (5) Architects Department.
- (6) Roads and Gardens.
- (7) Tramway.
- (8) Scavenging and Watering.
- (9) Gas.
- (10) Electric Lighting.
- (11) Helouan Water Service.
- (12) Ghiseh and Ghesireh Water-works.
- (13) Cairo Drainage.
- (14) Bridges.

Statement A.—The increase of work in terms of Caisse Credits for buildings only since 1895 is as 21:697 to 152:496 or 700 %.

In vindication of various shortcomings in the Service, more especially errors in estimating, I must plead the enormous accession of work and the extreme difficulty of finding men with qualifications adapted to the peculiar requirements of the country. The combined budgets of the various Services embraced by the Tanzim, including Special and Caisse Credits, amounted to £E.608,553.

An excessive strain is thus undoubtedly thrown on the few high-grade officials whose acquaintance with the country technical attainments and knowledge of French, marks them out as the sole channels for the regulation and control of the extremely diversified subjects presented to the Tanzim Department.

These officials are Messrs. Clifton, Hewat, Said Bey Choucri and Chapman.

Their operations extend from Alexandria to Aswan.

Projects have lately been designed even for Khartoum and Berber by Mr. Hewat. As additional temporary technical hands are required, we are obliged to recruit candidates whose capacities we know to be of an inferior order. By pensioning the officials who for various reasons are

unfitted for the important District posts which they now hold, and by substituting qualified engineers, our work would receive a much-needed impulse, and very large savings could be effected. It must be remembered that the efforts of an excellent employé, if only temporary, may be completely frustrated by the *vis inertiae* of his inefficient but permanent Chief. I feel that I am repeating yearly—*usque ad nauseam*—the same statement. I should however fail in my duty if I did not call attention to a state of things which grows more serious in proportion to the development of the area of Tanzim operations.

The institution of Local Commissions cannot, in as far as my Department is concerned, be considered a success. The energy of the Local Commission is rightly directed to the study of municipal improvements.

Projects for macadamising streets: establishing trottoirs: the introduction of patent systems of lighting: drainage: iron fencing round public gardens, filling in birkets, the establishment of pumps-engines, and reservoirs for street watering—all these questions are submitted to the technical Agents of the Tanzim. In the first place, therefore, the work of the Tanzim engineers is multiplied tenfold.

A much more serious matter however is the circumstance that not 5% of our Tanzim engineers, including the chief engineers, are capable of estimating or carrying out a single one of the above mentioned projects. At Kena the Mudir and Tanzim engineer ordered 3,000 cubic metres of round shingle, a most unsuitable material for road-making: estimates were exceeded by 53% and the Public Works Department were involved in a futile discussion, lasting several months, with the contractor.

Upper Egypt is incomparably worse off than Lower Egypt in as far as the inefficiency of the engineers is concerned.

I have lately detached a native mechanical engineer from Head Quarters to study the establishment of pumps at Kena and Sohag—the Tanzim engineers not possessing the most rudimentary knowledge of hydraulics or mechanics.

The only remedy for a situation which is productive of waste and inefficiency seems to me to lie in devoting a percentage of the funds now allotted to the Local Commissions, to the establishment of a special staff under the orders of this Department. All projects of every kind should be presented to and checked by this special office.

There are now 18 towns subject to Local Commission and one (Mansura) is endowed with a Municipality. The total credit of the 19 towns is in 1900 £E.29,100. Ten per cent of this amount should be deducted for "frais d'étude." As matters stand the funds are either wasted or, if a project is referred to this Department, very great delay is unavoidable owing to the pressure of more important work of our own.

The current work which a Tanzim engineer is supposed to execute in the various Directorates comprises—

- (1) Office work.
- (2) Supervision of cemeteries for Sanitary Department.
- (3) Superintendence of work under construction, plans, estimates for Public Works Department, small new works and repairs.
- (4) Tanzim alignments, contraventions of Vairie, dangerous buildings supervision.
- (5) Constant attendance on the Mudir and Local Commissions, designing streets, fences, studying pumps engines for water-works projects, drainage, lighting carts, harness, stabling, scavenging—all this for the Department of Interior and in addition to Public Works Department works.

I find that on the assumption that the foregoing duties still leave a margin of spare time, it has been the custom of the Service of Immeubles Libres, Finance Department, to use these same engineers to study requests for purchase of Government waste land.

Such examination necessarily requires levelling, surveying, measuring and map making, in addition to clerical work.

You will observe that even a high-grade engineer would find it difficult to keep pace with duties of so varied a nature. The Finance Department should be advised that it is impossible for our engineers to continue to attend to the work of the Immeubles Libres, and this in consequence of the great accession of work resulting from the institution of Local Commissions.

The towns affected would be:

Damietta.	Port Said.	Mansura.	Damanhur.
Zagazig.	Tanta.	Suez.	Chibin-el-Kom.

I would draw attention to the excellent work done by Messrs. Hewat Clifton, Said Bey Choukri, Chapman, Jacot de Combes, Curtis, Reboul, Powell, Fitzpatrick and Habib Effendi, Chief Accountant.

I annex statement showing:

- (1) No. of Public Buildings constructed, 1895-99.
- (2) Increase of work in my Department in terms of Budget.
- (3) Rise of price of iron.
- (4) Local Commissions Budget.
- (B) Comparison Staff and Budgets of Tanzim with and combined Irrigation Circles.
- (6) List of works executed on special credits from other Departments.
- (7) Detail comparison Staff combined Irrigation with Tanzim.
- (8) Details of Tanzim Service Budgets.

NEW BUILDINGS CONSTRUCTED, 1895-1899 UPPER AND LOWER EGYPT
APPROXIMATE FIGURES FOR WORKS UNCOMPLETED.

MINISTRY	No	CATEGORY	SUMS OF	Total £ E	Grand Total. £ E	%
Education Department	2	Custom Offices	1,730			
	2	Tobacco Stores	44,823			
	1	Archives	1,236			
	1	Tor Office	1,402			
	1	Petroleum Stores	2,336			
	1	Public Debt Office	1,932	53,430		8%
Justice Department	6	Tribunals	12,111			
	1	Court of Appeal	89,000	101,111		16%
Interior Department	25	Police Stations	15,618			
	3	Prisons	41,500			
	1	Coast Guard Station	1,200			
	1	Gouvernorat	18,000			
	1	Mudryeh	3,827	110,115		18%
	7	Schools	28,707	28,707		4%
Public Works Department	1	Geographical Society	952			
	1	Sea Wall	179			
	2	Museums	236,170	237,601		36%
Sanitary Department	24	Abattoirs	18,611			
	5	Hospitals	41,946			
	5	Disinfecting Stations	3,750			
	1	Hygienical Institute	1,363			
	1	Bacteriological Laboratory	1,560			
	2	Quarantine Stations	12,468			
	1	Kaser Army Director's House	3,350	116,018	647,074	18%
	96					100

INCREASE OF TANZIM WORK, 1895 TO 1900.

Year	CLASS-E						Combined Tanzim Ordinary Budgets.	Totals of Nos 5 and 7.	Totals of Nos 5, 6, 7.	Special Depart- ments.	Special Credit, plague- and Address- road	Grand Total.	Increase %
	Balance, previous year.	New Credits.	Total.	Sum spent on works completed.	Balance brought down.								
1	2	3	4	5	6	7	8	9	10	11	12		
	£ l.	£ l.	£ l.	£ l.	£ l.	£ l.	£ l.	£ l.	£ l.	£ l.	£ l.		
1895		306,040	306,040	27,697	281,343	110,928	162,625	146,968	17,966			191,931	
1896	281,343	50,000	331,343	30,629	303,714	117,097	177,726	181,440	5,929			187,369	
1897	303,714	20,000	323,714	46,231	277,483	171,358	217,589	195,072	17,500			512,772	
1898	277,483	111,918	389,401	101,600	281,831	173,429	278,029	562,860	27,291			590,151	
1899	281,831	62,000	346,831	452,496	191,335	195,178	317,671	512,000	55,311	11,200		608,553	
1900	191,335	120,783	315,118										
Totals.		670,771		555,653		827,990	1,183,613	2,528,319	151,230	11,200		2,693,779	

Columns 2, 7, 10 and 11 represent *active work complete* Column 4 represents *designing and projecting work*

PRICES OF IRON FOR BUILDINGS, 1899.

Quantity	Month												Rise in 10 months, %
	March	April	May	June	July	August	September	October	November	December			
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.			
Bridge girders . . .	6 15 0	6 15 0	6 15 0	6 15 0	—	—	7 12 6	7 15 0	—	8 15 0			29.6
Belgian girders . . .	5 12 6	5 15 0	6 0 0	6 5 0	—	—	7 7 6	7 7 6	—	8 0 0			12.0
Steel girders . . .	6 10 0	6 10 0	6 10 0	6 10 0	—	—	7 15 0	7 15 0	—	8 17 6			36.5

BUDGET COMPARATIF DES COMMISSIONS LOCALES POUR LES ANNÉES 1899-1900.

	Fentah		Assout		Mansourah		Fayoum.		Zagazig.		Suez.		Dinnette		Bamabou		Mimel		Chibou El-Kom.	
	1899	1900	1899	1900	1899	1900	1899	1900	1899	1900	1899	1900	1899	1900	1899	1900	1899	1900	1899	1900
Bar	—	110	—	100	—	—	—	—	—	—	30	50	—	—	—	—	—	—	—	—
Bedouin	128	735	100	615	300	710	116	175	150	150	210	260	250	250	200	218	350	375	50	60
Vaire	672	100	615	100	710	100	581	510	520	488	560	590	800	800	100	521	185	170	280	610
Travaux sanitaires .	100	50	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	30	30
Achat Ziadet lazzim .	75	50	10	20	50	50	25	15	21	17	70	70	—	—	80	80	5	5	20	20
Reserve generale .	125	75	75	50	10	10	75	70	100	117	30	30	50	50	120	78	60	50	10	80
Total	1,100	1,100	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,000	1,000	1,000	1,000	100	800

Total 1899. LE. 28,700
 „ 1900. „ 29,100

TRAVAUX SPECIAUX

SUR CRÉDITS OUVERTS PAR LES DIVERS DÉPARTEMENTS DE L'ÉTAT EN 1899.

	L. E.
Campement d'El-Tor	38,851
Caserne Gardes-Côtes, Port-Saïd (supplémentaire)	2,400
Markaz Guizéh	2,800
Ponceau à Zagazig	250
Logement Moudir Kallioubieh	1,500
Douane Ismaïlia	780
Caserne Police quais d'Alexandrie	1,870
Assainissement Mansourah	200
Etage sur Gardes-Côtes, Port-Saïd	1,200
Bordure trottoirs Zagazig	510
Macadamisage cour intérieure de l'Octroi à Kasr-el-Nil	500
Pares Quaranténaires du Mex (supplémentaire)	815
Eau d'arrosage à Benha	220
Nouveau jardin Kasr-el-Nil	1,400
Eau d'arrosage à Zagazig	290
Magasin Economat Moudirieh Gharbieh	1,500
Travaux Ecole Médecine	225
Total.	<u><u>L. E. 55,344</u></u>

PERSONNEL PERMANENT.

	<i>Ingenieurs.</i>	L.E.		<i>Bâtiments.</i>	L.E.
2	Inspecteurs Généraux	2,700	1	Directeur Général.	1,200
6	Inspecteurs	1,700	5	Inspect., S.-Inspect. et Direct., Trav. Spéc., Architecte et Architecte-Adjoint	3,280
1	Directeur du Barrage.	1,000	2	Architecte et Architecte-Adjoint	850
9	Directeurs des Travaux	1,660	8	Direct., Trav., Direct., Tanz. et Inspect., Bal., Ingénieur-Electricien.	3,470
1	Ingénieur-Mécanicien	120	1	Ingénieurs en Chefs 1 ^{re} Classe. L.E. 720	600
6	Ingénieurs en Chefs 1 ^{re} Classe. L.E. 2,160		2	2 ^{de} " " " " " " " " " " " "	900
8	" " " " " " " " " " " "	2,400	3	3 ^{de} " " " " " " " " " " " "	1,680
7	" " " " " " " " " " " "	1,680	7	Ingénieurs-Adjoints 1 ^{re} Classe.	1,110
37	Ingénieurs-Adjoints 1 ^{re} Classe.	6,660	8	2 ^{de} " " " " " " " " " " " "	1,296
39	" " " " " " " " " " " "	5,616	9	3 ^{de} " " " " " " " " " " " "	1,728
32	" " " " " " " " " " " "	3,156	16	4 ^{de} " " " " " " " " " " " "	1,794
34	" " " " " " " " " " " "	2,652	23	Surveillant des contrats.	9,558
19	Surveillants des contrats.	21,624	1	Ecrivains 3 ^{re} Classe.	300
1	Ecrivains 3 ^{re} Classe.	5,220	3	1 ^{re} " " " " " " " " " " " "	864
6	" " " " " " " " " " " "	1,188	4	2 ^{de} " " " " " " " " " " " "	792
15	" " " " " " " " " " " "	1,980	8	3 ^{de} " " " " " " " " " " " "	1,056
54	" " " " " " " " " " " "	3,888	20	4 ^{de} " " " " " " " " " " " "	1,110
43	Divers.	8,208	5	Divers: Gaz, jardins, balayage et arrosage. .	1,152
		1,860			858
323	Total.	53,392	126	Total.	21,268

POURCENTAGE PARTIEL DU TRAITEMENT PAR RAPPORT AUX DIVERS CRÉDITS DE LA DIRECTION GÉNÉRALE
DES VILLES ET BATIMENTS POUR 1899.

CRÉDITS PAR SERVICE.	MONTANT DES CRÉDITS.			MONTANT DES APPROUVEMENTS.			Pourcentage.
	Normal.	Spécial.	Total.	Permanents.	Non classés.	Total.	
	L. E.	L. E.	L. E.	L. E.	L. E.	L. E.	
Bâtiments-Budget	76,385	—	76,385	17,570	8,997	26,567	5.10%
„ Caisse Dette	—	346,831	346,831	—	—	—	—
„ par Département.	—	55,344	55,344	—	—	—	—
Villes des Provinces	41,559	—	41,559	—	—	—	—
Ville du Caire.	26,826	3,700	30,526	3,908	1,641	5,549	18.17%
Arrosage et balayage	26,400	7,500	33,900	1,194	1,104	2,298	6.77%
Eclairage au gaz, Caire	21,524	—	21,524	396	168	564	2.62%
Jardin de l'Ezbekieh.	2,481	—	2,481	—	329	329	13.24%
Total. . . L. E.	195,178	413,375	608,553	23,068	12,239	35,307	

(Of this sum £152,490 was spent requiring an executive staff. The balance represents designing work requiring Drawing Office Staff.)

DIRECTION. SPECIAL BUILDINGS. DELTA.

Sixteen works were taken over after the year's guarantee. There were only very slight repairs required in a few cases. The cost of these works was about £E.29,000 (See list A.).

Sixteen works have been completed at a cost of about £E.76,737. The most important were Mex Quarantine Park, Shibin-el-Kom Hospital, Port-Said Slaughter-house and Tor Quarantine Station (See list B.).

Works in progress.

About £E.91,248 were spent during the year on the first four works in list C. In the case of the last three, this Direction is only responsible for the stability of the buildings, the Prisons Department for the accounts.

1.—*Egyptian Museum*.—13,654 cubic metres of masonry have been added. The numerous sky-lights are being erected. The roofs over the grand and central halls, which are at a higher level, are being constructed, and with the dome should be completed in April 1900. It is difficult to fix a date for the entire completion of the building, as the internal plastering should not, I think, be finished off until the large statues and other objects to be ranged along the wall are in place.

2.—*Arab Museum and Khedivial Library*.—The foundations of this building were laid just as the subsoil water was at its lowest level. The works are progressing very satisfactorily and will be up to ground level in two or three months.

3.—*Cairo Native Court of Appeal and Prisons*.—Considering the magnitude of the buildings, the works are very well up to time. They should be entirely finished by the end of January 1900.

Considerable structural improvements have been introduced into the Prisons during construction.

4.—*Tor Quarantine Station*.—These works comprise three buildings for disinfecting the pilgrims and their effects. Each building has a separate landing jetty.

(2) A complete water supply and sewage system with pumping station.

The time allowed for these works (four and a half months) proved too short owing principally to workmen's strikes and storms and to the enormous difficulties of transport. Tor is situated in the desert at the foot of the Sinai Mountain, on the gulf of Suez and about 130 miles distant from the town of Suez. There are no regular means of communication with the latter. With the exception of stone, lime and sand, all building materials such as cement, hydraulic lime, bricks, girders, asphalt, woodwork, sewer pipes and water mains, besides skilled and ordinary labour, had to be transported from Suez by special steamers. Owing to the great efforts made by the Contractors, Messrs. Guétin & Charvaut, two buildings and jetties in addition to the water and sewage works were ready for the pilgrims at the beginning of May, and this improved accommodation was much appreciated by the Quarantine officials and the pilgrims themselves. When the pilgrimage was over the works were recommenced, and should be completed by the end of the year.

5.—*Port-Saïd Gouvernorat*.—The west wing is nearly complete, and it is hoped that the necessary funds will be granted to complete the project.

Three District Police Stations—at Toukh, Gallioub and Simbellawin—as well as residence for the Director of Kasr Aini Hospital, will be completed early in 1900.

The Manshia Prison is practically complete.

Tanta Prison should be finished in three months' time and Alexandria in six months. The first two are let to contract with a stipulation that prison labour be employed; and the last is being executed by daily labour, prisoners being used when possible.

General.—It is remarkable that out of twenty works only four have been taken by native contractors—two firms (each with two works). The rest of the works are being carried out by Europeans in the following proportions:—

11 Italian	. . . .	(eight firms).
4 French	. . . .	(two firms).
1 English	. . . .	—

Appended is a statement showing the number of buildings constructed for each Ministry since May 1895, by the Director, Special Works, North.

I have added a note, prepared by Mr. Pastour, on the foundations of the Mehallet Kubra Tribunal. The original foundation as projected was 3'00 deep. The site was on an old birket which had been recently filled in to a depth of 2'50.

By employing the Béton Armé System, the foundations were laid at a depth of only 0·45 on made earth. They have stood perfectly for two years.

SUMS SPENT ON VARIOUS DEPARTMENTS—MAY 1895 TO DECEMBER 1899.

<i>Sanitary Department.</i>		£E.
11 Abattoirs		9,066
3 Hospitals		33,078
5 Disinfecting Stations		2,407
1 Hygienic Institute		1,481
1 Bacteriological Laboratory		1,119
1 Mex Quarantine Parks		7,904
1 Tor Quarantine Station		41,579
1 Residence Doctor Kasr Ainy		3,235
		<hr/>
		99,869
<i>Justice.</i>		
3 Law Courts		13,380
1 Native Court Appeal		54,340
		<hr/>
		67,720
<i>Interior.</i>		
10 Police Stations		16,398
1 Coast Guard Stables		4,592
1 Coast Guard Residence		1,244
1 Gouvernorat		3,451
		<hr/>
		25,685
<i>Public Instruction.</i>		
4 Schools		14,697
		<hr/>
		14,697
<i>Finance.</i>		
2 Custom Offices		2,575
1 Tobacco Stores		23,016
1 Archives		1,363
1 Parcel Post		1,697
1 Annexe Caisse Dette		2,051
1 Petroleum Store		2,251
		<hr/>
		32,956
<i>Public Works Department.</i>		
1 Geographic Museum		980
1 Sea Wall, Port-Said		677
1 Egyptian Museum		112,986
1 Arab Museum		8,668
		<hr/>
		123,311
<i>Prisons.</i>		
3 Prisons		—
		<hr/>
		365,238

DIRECTION, SPECIAL BUILDINGS, DELTA.

List A.

WORKS TAKEN OVER FINALLY IN 1899.

Number.	NAME OF WORK	Total expenditure, final situation and overseers, £E	Date of final reception	Name of Contractor
1	Petroleum Store, Port-Said	2,252	3.2.99	P. Grinza.
2	Sea Wall at Port-Said	557	3.2.99	Dowrie & Co.
3	Annex at Abbas School	5,044	2.3.99	Marciano & Co.
4	Bacteriological Laboratory, Cairo.	1,119	30.5.99	N. Marciano.
5	Benha Slaughter-house	521	5.6.99	Megahed Sidh Ahmet.
6	Chibin-el-Kom Slaughter-house	556	5.6.99	Hes. Ahmed el Ghizani
7	Menouf Slaughter-house	651	5.6.99	Aly Ghoneim.
8	Zifta Slaughter-house	610	6.6.99	Aly Ghoneim.
9	Mit Gamr Slaughter-house	607	6.6.99	Aly Ghoneim.
10	Zifta Markaz	1,660	6.6.99	Ahmed Aly Ghoneim.
11	Kafr el Zayat Slaughter-house	538	7.6.99	Aly Ghoneim.
12	Coast Guard Stables, Port-Said	1,592	11.7.99	Dowrie & Co.
13	Port-Said School	5,918	11.7.99	Dowrie & Co.
14	Citadel Archives	1,363	2.9.99	W. Hamilton.
15	Choubrakhit Markaz.	1,628	22.9.99	Said Khalil.
16	Alexandria Parcel Post	1,697	22.9.99	N. Marciano.
Total. . . £E.		29,346		
Corresponding total for 1898. £E		35,525		

This list is subject to revision by the Accounts Department. The Accounts include other expenditures than those of this Direction.

DIRECTION, SPECIAL BUILDINGS, DELTA.

List B.

WORKS COMPLETED AND TAKEN OVER PROVISIONALLY IN 1899.

Number.	NAME OF WORK	Sanction	Final situation including 10% guarantee	Oversight.	Total expenditure total situation and oversights.	Economies or Excess	Date of provisional reception	NAME OF CONTRACTOR
		£E.	£E.	£E.	£E.	£E.		
1	Foundations of Primary School, Cairo	2,924	2,821	111	2,932	- 8	24.1.99	Basile Antoniou.
2	Annex Caisse de la Dette.	2,178	2,038	115	2,153	25	30.3.99	N. Marciano.
3	Foundations of Normal School, Cairo	910	848	57	905	35	18.5.99	Basile Antoniou.
4	Parks at Mex	7,900	7,630	274	7,904	- 4	26.5.99	N. Marciano.
5	Mehalla el Kobra Tribunal.	2,382	2,146	57	2,203	179	8.6.99	Aly Bedaoui.
6	Galioub Slaughter-house .	570	490	41	537	33	21.6.99	Gazzo & Fucile.
7	Ismailia Customs. . . .	780	710	43	753	27	21.8.99	Guerin & Charvaut.
8	Chibin el Kom Hospital .	5,507	5,401	106	5,507	—	9.10.99	Vigano Ing. Vitt.
9	First Floor, Coast Guard Stable, Port-Saïd	1,275	1,219	25	1,244	31	25.10.99	Guerin & Charvaut.
10	Alteration to Sea Wall, Port-Saïd.	120	120	—	120	—	1.11.99	Dowrie & Co.
11	Slaughter-house, Port-Saïd.	2,532	2,290	184	2,474	58	11.11.99	Zouro Patouna.
12	Tor Quarantine Station. .	11,580	10,941	598	11,539	41	28.12.99	Guerin & Charvaut.
13	Police Station at Tonkh. .	1,900	1,693	143	1,836	64	30.12.99	Badir Chenouda.
14	Police Station, Simbellawin.	1,750	1,673	77	1,750	—	3.1.00	Aly Bedaoui.
15	Residence for Dr., Medical School, Kasr el Aini. . .	3,350	3,152	83	3,235	115	4.1.00	Pezzi & Goussard.
16	Police Station, Galioub . .	1,720	1,534	111	1,645	75	31.1.00	Badir Chenouda.
	Totals. . . £E.	77,408	74,712	2,025	76,737	671		
	Corresponding total for 1898. . . £E.	26,024						

This list is subject to revision by the Accounts Department—Then accounts include other expenditure than those of this Direction.
Excess.

DIRECTION, SPECIAL BUILDINGS, DELTA.

List C.

WORKS STILL IN PROGRESS.

Number	NAME OF WORK	Sanction	Total expenditure to end of year 1899	Spent during year	Date of beginning	Expenditure to completion	Name of Contractor
1	Egyptian Museum. . .	£E. 191,499	112,986	49,862	2 1, 97	2, 3, 99	Garozzo & Zafrani.
2	Cairo Native Appeal Courts and Prisons.	64,000	54,340	29,994	13, 6, 97	13, 12, 99	Centonze, Marciano, Parboni.
3	Port-Saïd Gouvernorat	5,000	3,451	2,724	14, 8, 98	13 8, 99	Zouro Patouma.
4	Arab Museum. . .	50,000	8,668	8,668	31, 5, 99	30, 11, 01	Mansib, Tchaki.
	Total. . . £E.	310,499	179,445	91,248			
	Corresponding total for 1898. . . £E.	317,602					
	<i>Prisons.</i>						
5	Manshia.	—	—	—			Natali, Properi.
6	Tanta	—	—	—			L. Diamanti.
7	Alexandria	—	—	—			Messrs. Chio & Derling.

This list is subject to revision by the Accounts Department. The amounts include only the amounts paid by this Direction.

¹ This does not include Prisons.

WORKS CARRIED OUT BY THE DIRECTION. SPECIAL BUILDINGS. DELTA
FROM MAY 1895 TO DECEMBER 1899.

List D.

No. of Works.	NAME OF WORK	Total cost	Grand Total
		£E.	£E
11	Slaughter-houses (Damietta, Suez, Mehalla Kobra, Port-Said, Zifta, Menouf, Kafr Zayat, Mir Gamr, Benha, Chibin el Kom and Galiub).	9,060	
3	Hospitals (Kasr el Aini, Benha and Chibin el Kom).	33,078	
3	Law Courts (Dessouk, Mehalla el Kobra and Annex to the Mixed Tribunals, Cairo).	13,380	
10	District Police Stations (Faccus, Ashmoun, Talkha, Dessouk, Kouesna, Zifta, Choubrakhit, Toukh, Galiub and Simbel-hawin).	16,398	
5	Disinfecting Stations (Suez, Tanta, Damietta, Mansourah and Zagazig).	2,407	
4	Schools (Abbas, Port-Said, and foundations of Primary and Normal School, Cairo).	11,697	
2	Custom Offices (Suez and Ismailia).	2,575	
2	Tobacco Stores at Alexandria (and Annex).	23,016	
1	Coast Guard Stables at Port-Said.	1,592	
1	Coast Guard residence at Port-Said (First floor).	1,244	
1	Geographical Museum, Cairo.	980	
1	Hygienic Institute.	1,481	
1	Bacteriological Laboratory.	1,119	
1	Citadel Archives.	1,363	
1	Mex Quarantine Parks.	7,904	
1	Tor Quarantine Station.	11,579	
1	Alexandria Parcel Post.	1,697	
1	Annex to Caisse de la Dette.	2,054	
1	Port-Said Petroleum Stores.	2,251	
1	Port-Said Sea Wall.	677	
1	Residence for Director Medical School, Kasr-el-Aini.	3,235	
53			184,793
1	Egyptian Museum.	112,986	
1	Cairo Native Appeal Courts and Prisons.	51,340	
1	Port-Said Gouvernorat.	3,451	
1	Arab Museum.	8,668	
3	Prisons (Manchia, Tanta and Alexandria).	—	179,440
	Total.	£E.	365,238

This list is subject to revision by the Accounts Department—Their accounts include other expenditure than those of this Direction.

INSPECTION. LOWER EGYPT.

A sum of £E.51,731 was spent by this Inspection in 1899, as follows:—

Finance	13%	
Interior	23%	
Public Works Department	7%	
Justice	9%	
Public Instruction	44%	Including new schools.
Foreign Affairs	—	
War	—	
Sundries.	4	
	<hr/>	
	100	

Cairo Directorate	60%
East Directorate	20%
Delta Directorate	5%
Alexandria and West Directorate	15%

Owing to the very heavy work on which Mr. Clifton was occupied, the building of two schools, Nasrieh and Dar El-Ulum, which properly belong to the Special Works Inspection, were confided to the Cairo Inspection. A good deal of unrest has been observable among the Contractors for buildings in course of construction owing to the considerable rise in prices of materials. None however have so far thrown up their work, though considerable delay has occurred.

INSPECTION LOWER EGYPT (CHOUKRI BEY.)

The great extension of building operations points undoubtedly to an increasing purchasing power on the part of the inhabitants of the country. The construction by Government of public buildings in the districts is serving, I am glad to say, as a standard for imitation by the local magnates. Even the felaheen are substituting burnt for crude brick, and seem to be slowly imbibing the rudiments of the science of ventilation.

Considerable improvements have been introduced in the form of widening of streets and the establishment of public squares and gardens and the planting of trees.

Water works, on a small scale, have been started in Kafr Zayat, the water being lifted by a petroleum engine and supplied under pressure through pipes.

Heluan, Suez, Port-Tewfik, Port-Said, Ismailieh and Tanta are already supplied with Water-works.

Projects for the electric lighting of Mansura, Zagazig, Tanta and Damanhour have been submitted by representatives of European firms and are being studied by Mr. Jacot.

Port-Said is the only Provincial town lighted by gas.

Ten towns, of which the names are given on a separate statement, possess a proportion of macadamised streets.

A project of the drainage of Mansura is being studied and shortly be submitted to the Sanitary Department for final decision.

MUNICIPAL IMPROVEMENTS IN LOWER EGYPT.

NAME OF TOWN	Water-works	Nature of public lighting	Macadam.	
			Lin. metres.	
Benha	—	—	2,701	—
Suez	1	—	332	—
Port-Tewfik	1	—	927	—
Mansura	—	Electric (project.)	120	—
Damietta	—	—	2,912	Naples flags.
Zagazig	—	Electric (project.)	161	—
Ismailia	1	—	—	Suez Canal Coy.
Port-Said	1	Gas.	7,156	—
Tanta	1	Electric (project.)	450	—
Damanhour.	—	Do.	100	—
Heluan	1	—	—	—
Kafr Zayat	1	—	—	—

TABLÉAU N° I.

INDIQUANT LES TRAVAUX ENÉCUTÉS, DIVISÉS PAR MINISTÈRES

MINISTÈRES	NOMBRE DES TRAVAUX						SOMMES TOTALES PAR MINISTÈRES L. E.		%	OBSERVATIONS
	Au-dessus de L. E. 200		Au-dessous de L. E. 200		Nombre	Montant				
	Nombre	Montant	Nombre	Montant						
Finances	9	1,162	231	2,325	76	511	85	6,185	772	
Intérieur	11	8,921	118	3,135	128	393	139	12,055	711	
Travaux Publics	2	850	—	2,951	231	681	233	3,801	681	
Justice	6	3,220	582	1,266	13	623	19	4,187	205	
Instruction Publique	10	21,810	921	1,117	56	709	66	22,988	630	
Affaires Étrangères	—	—	—	16	2	—	2	16	—	
Guerre	—	—	—	16	2	—	2	16	—	
Palais Khediviens	—	—	—	91	1	—	1	91	—	
Travaux divers inférieurs à L. E. 10 payés sur l'avance	—	—	—	—	—	—	—	1,791	933	
Totaux	38	38,997	832	10,912	539	150	577	51,731	935	

TABLEAU N° II.

INDIQUANT LES TRAVAUX EXÉCUTÉS, DIVISÉS PAR DIRECTIONS DE TRAVAUX

	Travaux neufs	Travaux de réparations	TOTAUX
	L. E.	L. E.	L. E.
Direction du Caire	20,150	11,490	31,640
Direction de l'Est	4,593,510	5,881,241	10,477,754
Direction du Delta	781	1,760,241	2,541,241
Direction de l'Ouest	3,966,819	3,106,131	7,072,950
Totaux. . . .	29,491,329	22,240,616	51,731,945

TABLEAU N° III.

INDIQUANT LA HAUSSE DE PRIX SUBIE PAR LES MATÉRIAUX

BOIS		FERS	ZINC ET QUINCAILLERIES
Chez Stægm	Chez Scandou	Chez Kuster	Chez Phildun
de 12 à 20 %	de 15 à 23 %	de 25 à 30 %	de 30 à 40 %

TABLEAU N° IV.

LISTE DES TRAVAUX DE VOIRIE EXÉCUTÉS SOUS LA DIRECTION DES INGÉNIEURS DU TANZIM DANS DES PROVINCES DÉPENDANT DE L'INSPECTION DU NORD.

BUREAU DU TANZIM	Surface des routes balayées		Surface des routes arrosées		Surface du macadam rechargé		Surface des routes réparées		Surface des coulées exécutées sur les routes		OBSERVATIONS
	Mètres	Cent.	Mètres	Cent.	Mètres	Cent.	Mètres	Cent.	Mètres	Cent.	
Zagazig.....	1,667,610		1,280,755		—	—	35,155	—	510	—	
Damiette.....	110,383		158,230	—	—	—	20,650	—	—	—	
Damanhour.....	799,700		390,820	—	3,200	—	63,380	—	6,410	—	
Siouta.....	330,000		210,000		7,368	—	1,750	—	—	—	
Port-Saïd.....	1,592,551		2,016,652		56,539	—	17,209	50	—	—	
Tanta.....	1,281,502		1,085,918	96	6,306	—	166,580	—	27,618	—	
Kaf-s-el-Zayat.....	609,179		461,759		5,070	—	57,010	—	1,296	38	
Ziftah.....	729,377		372,615		—	—	111,976	—	—	—	
Mit-Ghamr.....	151,377		317,911		—	—	17,771	80	1,106	—	
Suez.....	86,682,016		62,775,308		—	—	13,535	02	—	—	
Medinet-el-Kobra.....	1,099,060		711,009	—	1,001	—	111,488	—	598	—	
Chahin-el-Kom.....	315,820		265,000		—	—	6,000	—	—	—	

TABLEAU N° V.

LISIE INDICANT LES TRAVAUX DU TANZIM PROPREMENT DIT
DANS LES PROVINCES DÉPENDANT DE L'INSPECTION

NOMS DES PROVINCES	Correspondances		Recettes de l'anziim		Recettes de Voirie		OBSERVATIONS
	Arrivée	Départ					
			L.E.	MIL.	L.E.	MIL.	
Tanzim Zagazig	1,316	1,453	513	691	067	001	
.. Benha	410	506	19	200	5	913	
.. Damiette	725	797	42	900	14	084	
.. Damanhour	1,279	1,643	54	921	39	770	
.. Heluan et Guizeli	425	530	51	850	—	200	
.. Tanta et Kafr-el-Zayat	1,042	1,227	116	120	384	295	
.. Mansourah	1,065	1,208	70	500	—	—	
.. Chibin et Menout	822	838	109	680	23	110	
.. Suez	891	917	43	720	78	335	
.. Mehallet el Kobra	832	849	58	130	92	700	
.. Zifta Mit-Ghamr	770	741	47	120	59	367	
.. Port-Saïd	1,611	1,727	61	720	217	601	

INSPECTION, UPPER EGYPT.

All works of importance in Upper Egypt have been carried out by Mr. Hewat, and are treated of in my Special Works Report. The institution of local Commissions has given, in as far as Public Works are concerned, most unsatisfactory results. The total enfranchisement of the local authorities, tempered only by the control and advice of an ill-educated and inexperienced Tanzim Engineer, has led to a considerable waste of public funds. The Tanzim Engineer is subject to the Governor, but owes a shadowy fealty to our Inspector. Matters are generally referred to my office only after initial and irretrievable mistakes have been committed. In a contract lately submitted, the local Commission at Luxor, through the Tanzim Engineer, had stipulated that excavation was only to be measured after it had been loosely thrown up, thus allowing the contractor about 20% profit on measurement only. The original price was already from 20 to 30% too high. The correspondence and trouble resulting is out of all proportion to the importance of the work. Local Commissions should be allowed to make suggestions only. All projects should be examined and checked by the Head Office and the Tanzim Inspector. To cover the expense of special work 10% of all allotments to Local Commissions should be credited to the Tanzim Budget. It should be made plain that the Tanzim Department is in no way responsible for the badly designed and mutilated projects put forward by Local Commissions. Further, the fact is apparently appreciated that a large demand for projects can only be met by the appointment of competent engineers paid off the Municipality Budget. As the Upper Egypt Tanzim has unfortunately for many years formed the dumping ground of incapable engineers of every grade, there is to-day no member of the permanent staff, with the exception of the Inspector, who is capable of designing or estimating the simplest of the projects suggested by the Local Commissions. The cost of repairs executed by the Inspection amounts to £E.3,867 and the budgetary allowances of the local Commissions to £E.9,750.

The cost of supervision, Head Office included, came to £E.3,183, or 23%.

1. — TABLEAU DES DONNÉES UTILES SUR LES VILLES.

Nombres	Villes	Population	Surfaces			Voies						Nombres des latrines	Population des routes
			des maisons,	des routes des villes	des villes	Surfaces des routes,			Longueur des routes,				
						Relaxes	Arroses	Macadam	Plantes	Relaxes	Tratons		
1	Louxor	1,561	311,500	75,100	386,000	39,700	11,150	—	—	2,700	—	10	9,000
2	Kench	3,313	571,300	78,900	653,200	78,900	32,000	7,300	1,200	11,000	220	150	18,150
3	Sohag	2,224	541,600	101,800	646,400	98,950	48,500	31,900	2,700	7,500	121	75	15,000
4	Assiout	6,316	1,705,000	295,000	2,000,000	143,500	151,500	—	1,500	22,000	600	230	28,840
5	Minieh	4,217	599,800	120,200	545,100	45,150	71,970	—	700	11,700	600	125	20,240
6	Beni-Souef. . . .	3,118	725,100	111,600	840,000	114,600	98,800	—	1,500	15,800	2,331	109	17,950
7	Payoum. . . .	5,268	—	200,000	1,120,000	150,000	64,000	8,300	1,200	6,000	—	100	28,000

TABLEAU II.

MINISTÈRES	Valeur et Nombre des Travaux				Dépenses par Ministère	OBSERVATIONS
	Nombre	Ardoissons de L. L. 200	Nombre	Ardoissons de L. L. 200		
		L. L.		L. L.	L. L.	
Finances.	8	403	1	450	853	
Intérieur.	72	863	2	615	1,478	
Travaux Publics . .	4	113	1	284	397	
Justice	30	1,029			1,029	
Instruction Publique	3	110			110	
Affaires Étrangères	—	—	—	—	—	
Guerre	—	—	—	—	—	
Palais Khediviaux.	—	—	—	—	—	
Totaux.	117	2,518	4	1,349	3,867	

TABLEAU COMPRENANT LA DÉPENSE FAITE POUR LE PERSONNEL DE L'INSPECTION
DU SUD EN 1899 (AGENTS TECHNIQUES).

INDICATION DU PERSONNEL		DÉPENSES ANNUELLES DU PERSONNEL			OBSERVATIONS
		Paiement	Pièces de	Ensemble	
		L. L.	L. L.	L. L.	
1	Service de l'Inspection . .	834	—	834	Dans la Direction des Travaux de Beni Souef, le commandant n'est pas titulaire, ces administrations ont des de 3 ^e classe qui de ce personnel ont la Direction.
2	Dir. des Trav. de Beni Souef	720	68	788	
3	„ „ Sohag . .	832	27	859	
4	Ingenieurs du Tazim . .	702	—	702	
	Totaux.	3,088	95	3,183	

III. — TABLE DONNANT LE PRIX PAR M² DE SURFACES COUVERTES

Numéros	DESCRIPTION DES TRAVAUX	Surface couverte M ²	Évaluation des travaux L. F.	Depense par mètre carré L. F.	CONSTATATIONS
1	Poste d'Elbehway	128	508	3,968	Construction nouvelle en maillons treillis- châssée avec étage sur le 1 ^{er} de la surface
2	Baïsse des machines élévatoires, Tahia . . .	75	215	2,866	Construction nouvelle en briques avec insu- lation toute spéciale
3	Poste de Louxor (sur la gare)	121	175	1,446	Construction en briques avec acandah
4	Chouma Sed Elmassiah	173	190	1,093	Grosse réparation
5	Étage sur Merkez Magaga	170	100	2,353	Construction avec acandah (en briques)
6	Prison Merkez Beni Souef	96	152	1,583	id simple en maillons
7	Écurie Merkez El Fachm	101	173	1,712	id nouvelle
8	Chouma Sed Kfousha	261	150	1,701	Grosse réparation et travaux d'agrandisse- ment
9	Étage sur Merkez Beni-Mazar	81	172	2,017	Construction avec acandah
10	id. id. Louxor	111	283	1,972	id id (en briques)

ARCHITECTS' DEPARTMENT.

In 1899, ninety-six projects, estimated at £E.296,687, were prepared for adjudication. Eleven designs, valued at £E.114,350, are in course of elaboration.

13,236 plans and copies were produced, necessitating the preparation and technological translation of 1,604 documents.

The most important projects are :—

	£E.
Port-Said Gouvernorat.	15,000
Main Fire Station	30,000
Post Office, Port-Said	25,000
Post Office, Cairo	11,000
Tobacco Stores	13,500
Alexandria Tribunal	25,000
Agricultural School (remodelling)	10,000
Arab Museum (completing)	50,000
Normal School	4,000
Karnak Temple.	48,000

The ever-present difficulty of finding competent assistants has been aggravated this year by the great development of building operations in Cairo. The rates of pay are not high, and the tenure of office uncertain as long as the salaries Budget only exists in the form of a percentage on intermittent credits granted by the Caisse. The influx of new employes recruited to cope with a large and sudden accession of work creates great confusion in an office where the number of permanent officials capable of directing and explaining is reduced to a dangerously low limit.

Our architectural staff is adjusted to our normal Budget of £E.73,395. The accession of designing work in 1899 is roughly represented by the extra Caisse credits amounting to £E.346,831 and credits allotted by other Departments equal to £E.83,941 or a total of £E.430,772. Intermittently, therefore, a staff five to six times larger than the normal is required. I do not see how we can do more than reduce to a minimum the inaccuracies which such a situation of necessity entails.

SPECIAL WORKS, UPPER EGYPT.

During the year, two Merkas Police Stations and five Abattoirs and one Dairy were completed at a cost of £E.7,458.

Buildings to the value of £E.27,035 are under construction.

The first mentioned are type constructions and give satisfaction to the Departments for whom they are designed. Since 1896, including buildings nearly completed, a sum of £E.77,827 has been expended on new works in Upper Egypt. The various Departments have benefited in the following proportions:—

<i>Public Instruction.</i>		£E.
3 Schools		14,988
1 Library		
<i>Sanitary.</i>		
2 Hospitals		25,353
12 Abattoirs		
<i>Interior.</i>		
15 Mekkas		31,427
1 Madrasah		
<i>Justice.</i>		
3 Tribunals		6,059

Mr. Hewat has devoted much time and trouble to the study of the requirements of the new schools, and a type has now practically been agreed to, which I think eminently suitable to a hot country.

Mr. Hewat has further succeeded in condensing a satisfactory type of Tribunal. The saving in time to our drawing office is very considerable. The type is approved by the Judicial Adviser in his Report of 1899.

Hospitals, as before, have been designed by the Sanitary Engineers, who follow our own previously accepted practise of adjudicating on general plans. This system is subject to the drawback of possible excesses over the estimate. As, however, many of the hospitals are now built to a type, their value can be very closely assessed.

Abattoirs are now built to type and give no trouble in construction.

Mr. Hewat is supplying some fourteen public buildings with water by means of hand-lift pumps sucking from tube wells. They act in a satisfactory manner and can deliver 83 gallons per minute.

The annexed statements give in a condensed form a general survey of the year's operations. I would draw special attention to the services rendered by Mr. Hewat in designing type buildings. His theoretical architectural skill is supplemented by an exact knowledge of special detail requirements in Egypt.

His assistance to this Department is invaluable.

UPPER EGYPT

ANNUAL REPORT FOR 1899.

Buildings completed, under construction, and buildings the plans for which were under preparation during the year 1899.

BUILDINGS COMPLETED IN 1899 AND THEIR COST

Number.	Towns.	Buildings	Sanctioned Estimate	Actual cost	Estimated cost	Excess	REMARKS
			£E	£E. Md	£E. Md	£E. Md	
1	Deirout .	Merkaz or Post Office Barracks.	2,004	1,986,465	16,585	—	100 per cent.
2	Biba . .	do.	2,032	2,025,240	6,760	—	100 per cent.
3	Luxor . .	Abattoir	500	466,821	33,176	—	50 per cent.
4	Mellawi .	do.	528	491,708	36,292	—	100 per cent.
5	Tahta . .	do.	1,007	980,572	24,128	—	100 per cent.
6	Manfalout	do.	875	914,770	—	39,770	100 per cent. 100 per cent.
7	Giza . .	do.	478	441,298	36,792	—	100 per cent.
8	Giza . .	Dairy	113	149,992	—	—	100 per cent.
		Supplies	—	—	—	—	
		Unsettled	—	—	—	—	
Total. . .			£E.	1,456,809	156,896	39,770	

2 Merkaz, 5 Abattoirs, 1 Dairy.

GOVERNMENT BUILDINGS CONSTRUCTED IN UPPER EGYPT FROM 1896 TO 1899
AND THOSE NEARLY COMPLETE

BUILDINGS IN UPPER EGYPT	1896	1897	1898	1899	TOTAL	Cost of each Category £E
Schools	—	—	2	1	3	14,838
Hospitals.	—	—	1	1	2	15,709
Merkez and Police Barracks.	4	4	3	4	15	27,600
Tribunals	1	—	1	1	3	6,059
Madirichs	—	—	1	—	1	3,827
Abattoirs.	1	2	2	8	13	9,644
Dairy, Giza (foundation). .	—	—	—	1	1	150
Total Number. . . .	6	6	10	16	38	—
Total Cost £E.	10,210	8,050	25,075	34,492	—	77,827

From the above table it will be seen that in 1896 and 1897 there were six buildings constructed; and in 1899, sixteen were in hand—eight completed and eight under construction.

The amount spent in 1896 was £E.10,210. In 1899, the actual amount paid on buildings completed and under construction amounted to £E.24,163.

Public Instruction	14,988
Sanitary Department.	25,353
Interior.	31,427
Justice	6,059

£E.77,827

BUILDINGS LET TO CONTRACT IN 1898 AND 1899 AND STILL UNDER
CONSTRUCTION, WITH THEIR SANCTIONED ESTIMATES.

Towns	Buildings	Sanctioned Estimates £E.	REMARKS.
Sennoures.	Merkez and Pol. Bar.	1,889	Type for 10 horses nearly completed
Sennoures.	Abattoir	519	5th Class and 3rd Class. Sanitary Service.
Biba	"	716	"
Magaga	"	786	"
E-sna	School	6,800	120 pupils, almost completed in 1899
Souhag.	Tribunal	2,500	Approximate amount for new type not yet sanctioned.
Giza	Merkez and Pol. Bar.	2,800	Type for 14 horses.
Assiout	Hospital.	11,025	Almost completed in 1899
Beni Souef	Prison and Hospital .	—	Supervision of materials and workmanship only.
Total £E.		27,035	

2 Merkezs, 3 Abattoirs, 1 School, 1 Tribunal, 1 Hospital, 1 Prison.

SCHOOLS IN UPPER EGYPT BELONGING TO THE MINISTRY OF
PUBLIC INSTRUCTION

Number	SCHOOLS	Population	Built in	NUMBER OF PUPILS				
				1899.	1898.	1897.	1896.	1895.
1	Giseh.	16,877	1883	98	94	107	98	96
2	Beni Souef	18,088	1872	155	168	240	252	219
3	Fayoum	32,765	1888	147	145	167	170	169
4	Minia	23,964	1898	225	246	242	209	194
5	Assiout	11,863	1868	213	191	193	224	215
6	Sohag	14,512	1890	104	102	118	105	120
7	Kena	27,478	1890	89	99	116	125	121
8	Ezna	15,826	1900	86	70	71	73	64
9	Edfou	14,261	1891	81	81	70	65	55
10	Assouan	13,101	1898	129	117	99	92	104
11	Halfa	18,862	1895	48	90	58	45	68
12	Suakin	—	1895	56	80	72	62	94
				1434	1483	1556	1517	1519

SCHOOLS IN UPPER EGYPT NOT BELONGING TO, BUT UNDER THE CONTROL OF,
THE MINISTRY OF PUBLIC INSTRUCTION.

Number	SCHOOLS	NUMBER OF PUPILS				
		1899.	1898.	1897.	1896.	1895.
1	Coptic School (Beni-Souef)	51	131	Not under control of Ministry		
2	Tewfik Boys' (Fayoum) .	75	62			
3	Tewfik Girls' (Fayoum) .	72	73			
4	Beba Boys' (Beni-Souef) .	100	—			
5	Beba Girls' (Beni-Souef) .	48	—			
6	Sheikh Fadl.	87	61			
7	Deirout, Kairiah Assiout .	93	67			
8	Tahra.	216	235			
Total		712	632			

List of ABYCTORS IN Upper Egypt to END OF 1899, WITH THEIR COST.

No	ABYCTORS	Killing- Area sq. metre	Population	Cost	Built in	REMARKS
1	Beni Nohel	213	18,058	CE	1896	1st Class floor raised to bank level.
2	Fayoum	126	32,763	1,626	1895	ground level
3	Assiout	213	41,863	1,555	1894	"
4	Minia	120	23,946	1,050	1894	"
5	Kena	75	27,478	1,654	1895	"
6	Helwan	96	5,577	799	1896	2nd Class ground level in the desert, ground level
7	Soloe	96	11,512	692	1896	ground level in the desert, ground level
8	Girga	58*50	17,793	635	1897	"
9	Luxor	—	10,638	553	1897	"
10	Mellawi	—	46,261	466	1899	" 1 metre above ground level
11	Gizeh	—	16,377	494	1899	"
12	Tahia	—	17,404	412	1899	"
13	Sennoeiris	—	12,579	980	1899	In a basin floor about 3 metres above basin level
14	Bila	—	12,750	519	1899	Under construction 1 metre above ground level.
15	Magaga	—	7,063	716	1899	" raised to bank level.
16	Manfalout	—	15,215	786	1899	"
				914	1899	In a basin, floor 2.50 above bank level

BUILDINGS FOR WHICH THE CONTRACT AND OTHER PLAN ARE BEING
PREPARED IN MY OFFICE.

TOWNS	Buildings	Approx Estimate	REMARKS
		£E	
Assiout. .	New Moudirieh . . .	20,000	These plans were completed in 1899.
Gizah . .	School of Agriculture . .	25,000	This includes a new School, alterations to existing buildings and three dwelling-houses
Souhag. .	Tribunal	--	New type
Assiout. .	Tanzim Offices and Rest Houses	5,300	
Beni Souef. .			
Souhag. .			
Fayoum . .			
Minia . .			
Gizah . .	Cow-shed	500	For Agricultural School (12 cows)
Assiout. .	Hospital	6,000	52 beds.
Khartoum . .	"	20,000	200 beds ("Avant projet" only)
Dongola . .	"	3,000	120
Kassala: . .	"		
Cairo . .	War Office	2,000	For 80 Employés
Tahita . .	Tribunal	2,500	New type plans
Tahita . .	Markez.	1,800	Type plans
Esna . .	"	1,800	"
	Total. . . . £E.	87,900	

ROADS.

77,598 square metres of basalt roads have been added in 1899.

The various labour coefficients given in my 1898 Report have remained within reasonable limits. The price of carting is in every case higher owing to the number of buildings in course of construction.

81,778 square metres of limestone road were picked up to a depth of 0.08 and remade with basalt.

On this head an economy of 15 millimes per square metre is shown, resulting from the familiarity of the men with the work.

The new Abbas Road cost £E.4,034 for 36,191 square metres. The mean thickness of limestone is 0.28. A basalt top surface should be added as soon as funds permit.

The annexed statement, page 2, comprises the year's operations.

14,266 cubic metres of basalt were extracted from our Abu Zabel quarries by the Prisons Department (convict labour). The stone was well broken and delivery uninterrupted.

Limestone macadam to an amount of 19,010 cubic metres was quarried at Abbassiyeh by piece work. The cost came to P.T. 14 per cubic metre at site.

The Roads Budget having remained constant, the detail statements of requirements given in my 1898 Report still hold good.

ROAD MAKING AND REPAIRING, 1899.

Category	Depth Road		Cost, sq ARE METRE		Total spent 1899	No. of square metre	Name of road.
	98	99	98	99			
Road patching (hand)	Mill	29	Mill	93	2,190	231,800	Limestone
Recharge ment partiel (bullock)	74	100	14	27	308	11,228	"
" general (bullock)	80	86	26	29	720	25,139	"
" (steam)	115	69	61	36	2,058	56,765	"
"	83	76	53	33	2,680	81,778	Basalt
Reconstruction (steam)	135	137	76	70	5,435	77,546	"
New Roads (steam)	—	280	—	95	3,778	39,581	Limestone
" (bullock)	131	125	38	31	519	16,612	"
"	—	—	—	688	503	731	Asphalt.
"	—	—	—	1,081	53	49	Wood.
Level ling (hand)	—	—	—	—	580	638,387	Earth.
"	—	—	106	116	688	(fin.) 16,493	Kerb.
Total.					19,512		

GARDENS AND NURSERIES

CATEGORY	No. of Trees.	Area	Total Cost of upkeep	Cost per unit.	Cost levelling and preparing.
			Sq. Metres	£E	Mul.
Tree watering	99,887	—	825	8.3	—
Pruning trees, upkeep, planting, transplanting	27,675	—	891	32	—
Giseh Nursery	41,231	47,700	483	11.7	—
Public Squares and Gardens .	—	99,178	1,232	12.4	—
Gesireh Nursery	—	—	—	—	1,201

GISEH ROADS.

The area of macadamised roads on the west bank of the Nile is 211,000 square metres. A sum of £E.2,408 was expended on new work and £E.560 on repairs. Soft limestone was used in every case except on the short length between Kasr el Nil and English bridges. It is worthy of note that the soft stone wears very evenly in the Giseh section and shows results entirely different from our Cairo experience.

This is probably owing in part to less heavy wheel traffic, and in part to the ever present layer of mud brought in by the stream of animals of every kind. This seems to afford a protective covering to the macadam surface. I think that the Giseh and Gesireh roads should not be maintained off our Cairo Budget but be charged against Cetroi Receipts.

Some very heavy detail survey work was carried out by the Voirie Engineers, to enable us to present projects for the opening of new roads as indicated on annexed sketch map. Several companies delegated representatives to study our plans and estimates.

These estimates indicated the probable cost of expropriation and (approximately) the increased selling value of the expropriated sites after the establishment of a broad thoroughfare. A sum of about £E.450 was spent off our budget for this purpose. So far no firm offers have been received.

RAPPORT DES DÉPENSES D'ENTRETIEN DE LA VILLE DE CAIRO AVEC LES RECETTES DES DROITS SUR LES PROPRIÉTÉS URBAINES

AN NÉES	ENTRETIEN DE LA VILLE	DÉPENSES POUR ENTRETIEN		AUGMENTA- TION PROGRESSIVE	DROITS SUR LES PROPRIÉTÉS URBAINES		OBSERVATIONS
		Relevage et Arrosage	Eclairage		Montant	Augmentation progressive	
	L.E.	L.E.	L.E.	L.E.	L.E.	L.E.	
1895	37,264	17,577	20,909	75,747	—	—	
1896	33,900	21,911	20,921	75,868	+ 0,159%	Dimin. 1,071 %	
1897	33,650	22,291	20,921	76,868	+ 1,315%	Augm. 2,181%	
1898	34,398	21,372	20,921	76,691	— 0,200%	„ 3,197 %	
1899 Elzebelieh . .	26,826 2,881	26,400	21,521	77,231	+ 0,701%	„ 1,215 %	
1900 Elzebelieh . .	26,826 2,881	26,400	21,171	77,181	— 0,207 %	„ 4,597 %	

Augmentation dans le quinquennal 1895-1900 :

— sur l'entretien L.E. 1,897 %

— sur les droits, L.E. 13,75 %

EZBEKIYEH GARDENS.

A considerable amount of work has been done in 1899 out of the gate money. The grotto has been reconstructed and fitted with a small aquarium and miniature cascades.

The outer garden paths have been macadamised and new cesspools built for the restaurant. The band stand and lamp posts, bridges, etc., have been repainted, the greenhouses fitted with hot water apparatus and a number of plants purchased. The fitting and renewal of incandescent gas apparatus had, in 1898, been executed by a contractor for £E.140 per annum. Mr. Curtis, by purchasing in the open market and using the existing skilled staff at Gizeh for fitting, has economised £E.75.

The amount of water required for gardens has long been a vexed question :—

In 1897.	87'024 cubic metres.
.. 1898.	68'045
.. 1899.	48'000

The latter amount appears amply sufficient for the grass, trees, shrubs, and flowers. The duty works out to cubic metres 2'400 per feddan per annum. The gate receipts show a slight increase on 1898 and are nearly £E.1,000 in excess of 1897 :—

CATEGORY	1897.	1898	1899	Economy on 1897.
	£E	£E	£E	£E
<i>Income.</i>				
Gate money	307	1,255	1,300	993
<i>Expenses.</i>				
Cost of collection.	330	310	222	
Cost of gas.	685	310	365	
Cost of water.	969	544	481	
Repairs to pipes	203	21	0	
Cost of working	200	41	42	
Supervision	644	607	655	
£E.	2,758	1,836	1,768	990

Although 16 new barges were added

TRAMWAYS.

Below I give a number of data with regard to the Tramways.

TRAMWAYS (JULY 1898 TO JUNE 1899.)

1.—*Generalities.*

Date opening line	12th August, 1896.
No. of years concession	50
Expiration in year.	1946

2.—*Traffic.*

Voyages per day	620
Mean daily No. of passengers	27,003
Mean in per cent of population Cairo	4.75
Trains multiplied by kilometres	1,902,234
No. of employes	354

3.—*Financial data.*

Gross revenue	Fr. 1,355,086.79
Total cost . . . . .	.. 770,958.56
Total in per cent of revenue . . . . .	.. 57%
Interest on shares . . . . .	.. 5%
Balance available for distribution . . . . .	.. 49,039.01
Sum carried to Reserve . . . . .	.. 27,243.89
Revenue per car and per kilometre . . . . .	.. 0.71

4.—*Line and Cars.*

Length of single track line	6,522 metres.
Length of double do.	16,212 ..
Total length of line	22,734 ..
Area occupied by tramway	102,303 sq. metres.
Area in per cent of macadam streets	8%
Weight of rail per metre:	
City lines	36 kilog.
Pyramid line	24 ..
No. of motor cars	83 ..
No. of trailers	59 ..

5.—*Overhead construction.*

Length of trolley wire	36,500 metres.
Gauge	825 millimetres.
Length of feeders	1,250 metres.
Material of conductors	Hand-drawn copper.
Height of trolley wire from road	6 metres.
Insulation from earth.	Double.
Maximum loss of voltage in lines	10 .
System for fixing trolley wire: Span wires fastened either to the houses or to side poles, here and there side poles with brackets.	
No return feeders, return-current through rails which are doubly bonded with 8-millimetre copper bonds, now and then cross bonds.	

6.—*Locomotive plant.*

No. of generating units	4
Plant capacity in HP.	1200
Output in kilowatts (maximum)	800
Station voltage.	550 V.

Dynamos:

System Thomson-Houston, multipolar, hyper compound.

Steam-engines:

System Tosi, Milan, horizontal, tandem compound, surface condensing.

Power, normal 300 HP.

.. maximum 370 ..

Steam consumption per H.P. per hour 6.5 kg.

Boilers:

No. of boilers 4

Type Galloway.

Heating surface of each 110 square metres.

Working pressure 10.5 atm.

Evaporating power—normal 2,000 kgs. per hour.

.. .. maximum 2,700

The rolling stock is not of first-rate construction. No first class accommodation is provided, and the convenience of lady passengers is in no way consulted.

The working staff are of a slightly better class. The responsibility for the numerous accidents may be divided equally between the public who are incredibly careless, and the drivers of the cars who seem in many cases to lack ordinary intelligence.

The tramway regulations are still before the Mixed Courts, Government can therefore exercise no pressure on the Company.

Under no circumstances should an extension of the tram lines be permitted unless a width of 5.50 metres is secured for ordinary carriage traffic.

Mr. von Goehausen, our Inspector, has acquitted himself very well of the ungrateful task of endeavouring to carry out regulations which, though drafted, and known to both sides, yet are not binding until approved by the Mixed Courts.

SCAVENGING AND WATERING.

- (1) An area of 1,708,545 is cleaned out of the total surface of the Cairo roads which amounts to 2,781,741 square metres.

The latter figure may be divided into:—

Paved roads	1,338,445 square metres.
Earth roads	1,443,296 ..
	<u>2,781,741</u>

- (2) Gradual improvements in the service and thorough overhauling of stores and checking of issues by Mr. Fitz Patrick has lowered the previous coefficient of £1.18 per 1,000 square metres to approximately £1.17 $\frac{1}{4}$.

Annexed are carefully checked details of the cost of this service.

Every cart lent to the Voirie for transport of stone economises approximately P.T. 5 per day on contractors' prices.

The Voirie Budget has in this way saved about £1,000 in 1890. Mr. Powell's Report gives further details.

(1) *Area.*

No increase of area has been cleaned or watered on the Normal Budget this year.

An area of 1,708,545 square metres is cleaned out of a total of 2,781,741 square metres.

The cost of scavenging 1,000 square metres is £E.7 434 mill., and of watering £E.9 838 mill. Total £E.17 272 mill. as against average European cost of £E.32.

The normal area that can be properly maintained on the budget is 1,360,000 square metres. As stated last year, any increase is at the expense and to the detriment of this area.

The area watered has not been increased, but a great deal of water has been used in front of the steam rollers. An economy of 12,274 cubic metres of water is shown against the expenditure of last year.

(2) *Staff.*

The staff continues practically the same, with the exception of an English Deputy Chief Inspector, who may now be considered competent to act as Inspector in my absence.

(3) *Carts.*

Carts are made at the Government Arsenal, and continue to give the same satisfaction as heretofore.

£E.910 was spent on new carts.

Repairs, etc., to carts, cost £E.1,208.

(4) *Materials.*

Service materials from England cost £E.1,600. The greater part of these will not come into use until next year. All bought material practically comes from England now, including all harness material required for the service.

(5) *Forage.*

Forage cost us £E.6,245 as against £E.6,910 of last year, although this year we have employed an average of 30 more animals daily. In the coming year the forage will probably be considerably increased in price.

(6) *Animals.*

We have now 442 animals. During the year three died from natural causes, twenty were destroyed on account of old age, chronic disease, etc., and forty-two were sold.

(7) *Scavenging.*

Scavenging in the main street is now, I may say, excellent. In spite of the great difficulty owing to the filthy habits of the natives

and want of properly enforced regulations, I consider the main streets equal, if not better, to those of European cities.

(8) *Rain Work.*

Rain work is carried on in the same manner as last year and under the same difficulties. Continuous rain would entirely break up the organization and material of the service. During the six days of rain work, from 4th to 9th October, 12,158 carts of water, slush and mud were removed; and after the rain on the 8th November, 5,000 carts. The weight of a cart of slush is double that of ordinary sweepings and greatly strains the mules.

(9) *Labour.*

The price of labour is steadily increasing: stone cart drivers are receiving six piasters a day for outside work, against five piasters Government pay.

(10) *Outside Work.*

The service has received the following amounts for work executed on outside demands:—

	£E.	Mill.
Saddler	235	350
Tailor	150	000
Forage	105	293
Materials	34	777
Earth and sand	11	000
Siftings: manure, etc.	218	559
Hire of carts	208	780
Total	£E.963	759

as against £E.567 for last year.

(11) *General.*

I can not too strongly praise the service of Mr. Fitz Patrick during the heavy work of the year. Throughout he has done his best and given entire satisfaction.

(B) PLAGUE CREDIT.

On the 13th June 1899 the cleaning of the Native Quarters commenced under a special Credit from the Sanitary Department of £E.900 per month. At the end of December these quarters will revert to their original state of filth. The accumulation of rubbish in the Native baths, in spite of the precautions taken, is immense. The cleansing has been carried on by 175 sweepers and 60 carts, and on the same plan as during the cholera time of 1896.

Inhabitants living for years in a state of filth cannot be taught in a day to keep their houses, etc., clean. This fact must be taken into consideration when criticizing results.

COEFFICIENT FOR SWEEPING.

(A)—Cost of supervision in stables:—Stables (7); Animals (442); Carts (500).

	£E.	Mill
Total annual expenses	3,207	—
Deduct 15% on account of 65 Tanzim animals	481	—
	<hr/>	
Total per annum...	2,726	—
	<hr/>	

(B)—Cost of supervision in streets per annum = £E.1,389 960 milliemmes or
£E.324 757 milliemmes per 100 men.

(C)—Streets:

	£E.	Mill
Machine Brushes 15 @ 230	1,259	250
Sweepers 210 @ 10	3,066	—
Dust Carts 80 @ 150	4,380	—
Double Dust Carts 6 @ 200	438	—
	<hr/>	
Total	9,143	250
Supervision in streets	1,389	960
Supervision in stables (less £E.550 to watering)	2,176	—
	<hr/>	
Total for 1,708,545 sq. metres	12,709	210

$$\therefore \text{ For 1,000 sq. metres } = \frac{12,709}{1,708} = 7.440$$

COEFFICIENT FOR WATERING.

(A)—Accepted basis for daily charge for one water-cart complete:

	Mills
Mule	141
Cart	257
Harness	46
Forage	500
Driver... ..	500
Stabling	64
	<hr/>
	1508
Add 10% supervision	150
	<hr/>
Total	1658 (or 166 milliemmes per day).

(B)—One cart in one hour waters 2,165 sq. metres twice, or 4,330 sq. metres once.

One cart in one day of 7 hours waters 13,000 sq. metres twice, or 26,000 sq. metres once.

1 litre of water covers 1 sq. metre and costs 8 mills. per cubic metre.

	Mills.
26,000 sq. metres require $26 \times 1 = 26$ cubic metres at 8 mills. =	208
To which add for cost of cart	166
	374

Gives as cost to water 26,000 sq. metres once daily... ..

Or to water 1,000 sq. metres once daily = $\frac{1,000 \times 374}{26,000} = 14$

	waterings
(C)—(1) 2 waterings daily during 210 days of hot weather. ...	= 420
(2) 1 watering daily during 150 days of cold weather ...	= 150
	570
Total ...	570

	cE. Mill
To water 1,000 sq. metres during } 210 days hot weather }	= $\frac{1,000 \times 374 \times 420}{26,000} = 6 \quad 041$

	cE. Mill
And to water 1,000 sq. metres du- } ring 150 days cold weather ... }	= $\frac{1,000 \times 374 \times 150}{26,000} = 2 \quad 158$
	199

Total per 1,000 sq. metre.... ..

Add for wastage, extra waterings, etc. 20%

Total... ..

Cairo, 18th June, 1899.

THE DIRECTOR GENERAL.

TANZIM.

SIR,—I beg to submit the following notes which I have elicited with regard to the native baths, and which may prove interesting just now.

As a general rule the baths are all worked on the same principle, and serve the following purposes :

- (1) The ordinary purpose of a Turkish bath.
- (2) The sale of ashes which are used in the making of mortar (Kosromel.)
- (3) The cooking of beans for food.

The ordinary charge for a bath is 1 P.T.

The fires are kept going by street rubbish, etc., which is collected and stored on or about the premises for fuel.

The rubbish is collected by scavengers, and a large supply is, undoubtedly, obtained from our dust cart drivers.

Four cubic metres of rubbish make 1 cubic metre of ashes, which is again sold for 10 P.T. ; thus 1 cubic metre of rubbish equals about $2\frac{1}{2}$ P.T.

The beans are handed to the baths each evening by the shopkeepers to be cooked for the following morning. They are cooked in jars at a cost of 1 P.T. a jar. The water in which the beans have been cooked is given to the goats and sheep, which accounts for the number of those animals invariably found in the baths.

Also, the employes obtain a certain amount of their food by petty pilfering from the jars of beans. This pilfering appears to be accepted as a matter of course.

The baths do most business during winter and Ramadan.

The profits of a bath equal perhaps 50 P.E. daily, and are divided in the following proportion :

To owner of bath.	. . . . .	Half
To Reis . . . . .	. . . . .	One quarter
To scavengers . . . . .	. . . . .	One quarter

It is a noticeable fact that the natives employed are as a rule very strong-looking and stout : my informant very aptly replied to my comment on this "that pigs fatten on filth ; why not men ?"

LIST OF NATIVE BATHS IN CAIRO.

No.	Sectional No.	HAMMAM.	LOCALITY	Estimated amount of rubbish, stacked and in place for many years	REMARKS.
				Cubic metres.	
			<i>In Section I.</i>		
1	1	El Dahabeh . . .	Bab el Fetouh Fagallah. . .	82	Very dirty. Rubbish in space behind bath.
2	2	El Bi-shri . . .	Bab el Fetouh Fagallah. . .	199	Fairly clean.
			<i>In Section II.</i>		
3	1	El Chaaraoui . . .	Charch el Charaoui el Gouani .	188	Very dirty.
4	2	Amir el Gionche . .	19. Charch Amir el Gionche el Gouani	18	(Hearat No. 23). Very dirty.
5	3	El Gamalyeh . . .	16. Charch el Gamalyeh . . .	26	Very dirty.
6	4	El Salehiah . . .	Haret el Salehiah	72	"
7	5	El Edoui	Charch el Chanaouani	36	"
8	6	El Makassisse . . .	Charch el Makassisse	33	"
9	7	El Nahhassine . . .	Charch el Nahhassine	52	"
10	8	El Bisri	Charch el Khoronfeche	173	"
11	9	El Yhoud	Charch Mahmoud	86	"
12	10	El Sultan	6. Zadak el Mestaoukad . . .	170	"
			<i>In Section III.</i>		
13	1	Gane el Ahmar . . .	26. Sharia Gamb el Ahmar. .	111	Very dirty. keeps refuse on both sides of the street.
14	2	El Hadrah.	Haret el Hadrah.	227	Extremely dirty.
15	3	El Kharratine. . . .	4. Darb el Mestaouked	203	"
16	4	El Tambali	24. Darb el Mahkamah	393	"
17	5	El Antaret el Guiedida	16. and 17. Charch Antaret el Guiedida	62	Very dirty
			<i>In Section IV.</i>		
18	1	El Telata	6. Charch Hammam el Telata .	240	"
19	2	El Sharabi.	16. Charch el Hamzaoui el Kebir	185	"
20	3	Sabaa Kaat	77. Haret el Sabaa-Kaat el Kebliah.	46	"
21	4	El Sanadiéh	7. Atfet el Taouil.	125	Not working.
22	5	El Halwagi	101. Charch el Sakkeh el Gueddah	6	Dirty.
23	6	El Masbagha	13 and 15. Charch Hammam el Mastagha	23	Very dirty.
24	7	El Kahkine	Atfet el Hammam el Chouriah; off Charch el Kahkine	70	"
25	8	El Guibeli	11. Atfet el Guibeli	23	"
			10. Haret el Hammam (two entrances)		
26	9	El Soukarieh	16. Atfet el Alaïli	133	"
27	10	El Manassarah	18. Haret el Amir Hussein . .	63	"
28	11	El Soorooghié. . . .	Haret el Hennah.	50	"
29	12	El Doude	Charch Mehemet Aly	70	Fairly clean.
30	13	Souk el Selah. . . .	3. Charch Souk el Selah	361	Dirty.
31	14	El Bachtrak	Atfet Hammam Bachtali	131	Very dirty.
32	15	El Wazir	4. Charch el Wazir	18	"
33	16	El Roum	38. Charch Darb el Ahmar (rubbish at 5 Haret el Roum). .	81	"
34	17	El Kerabiah	Charch el Kerabiah (opp.No.12)	172	"

LIST OF NATIVE BATHS IN CAIRO—*concluded.*

No.	Sectional No.	HAMMAM	LOCALITY	Estimated amount of rubbish, stacked and in place for many years	REMARKS
			<i>In Section VI.</i>	Cubic metres.	
35	1	El Barodieh . . .	28. Haret Abou Kedra . . .	30	Fairly clean
36	2	El Sonkkor . . .	Arfer el Ensari: off Darb el Bagamone . . .	125	"
37	3	Mustapha Bey Hamifi	8. Arfer el Cheikh Edriss . .	119	Very dirty
38	4	El Marzouk . . .	Arfer Marzouk . . .	315	"
39	5	El Guidide . . .	Arfer el Hammam el Guidide .	652	"
40	6	Darb el Gamiss . . .	Sharia el Saideh Zennab . . .	50	"
41	7	El Baba . . .	Arfer Hammam el Baba . . .	97	"
42	8	El Alfi . . .	Haret el Alfi . . .	250	"
43	9	El Nasreyeh . . .	Sharia el Nasreyeh . . .	78	"
			<i>In Section VII.</i>		
44	1	El Kakhvah . . .	28. Sharia Abdin . . .	252	Extremely dirty.
			<i>In Section VIII.</i>		
45	1	El Sheikun . . .	50. Charch el Rokbiah . . .	144	Very dirty
46	2	El Tiloun . . .	101. Charch Tiloun . . .	101	"
47	3	Saiedah Sekinah . .	Charch Saiedah Sekinah . . .	148	"
48	4	Darb el Hosr . . .	Charch Darb el Hosr . . .	148	"
49	5	El Attarine . . .	Charch el Attarine . . .	632	"
			<i>In Section IX.</i>		
50	1	Said el Bahr . . .	Sharia Saiedah: off Sharia Mase el Ateeka . . .	100	Very dirty
			<i>In Section XI.</i>		
51	1	El Khatire . . .	Charch Khatire . . .	77	"
52	2	El Sanarieh . . .	Charch Sanarieh . . .	158	"
53	3	El Ouasti . . .	Charch el Ouasti . . .	203	"
54	4	El Etnain . . .	Charch el Hammamat . . .	43	"
55	5	El Arbaa . . .	Charch el Ansareh . . .	148	"
56	6	El Wagha (also called el Gomaa) . . .	Charch el Wagha . . .	212	"
			Total rubbish. . .	8,013	
			Add 20% for rubbish not stacked; lying loose in baths . . .	1,602	
			Total cubic metres. . .	9,615	

I have the honour to be, etc.,

(Signed) H. L. FITZ PATRICK.

GAS SERVICE.

The gas supervision office, previously under the orders of the Cairo Governor, was handed over to my Department in April 1899.

Some instructive statistics are given in Statement No. 1. In 1896, for reasons purporting to be in the interests of economy, all Gas Inspectors were dismissed and the duty of supervision transferred to the Police. The economy realised amounted to £E.293. The dismissed Inspectors had however levied fines amounting to £E.325, and thus, while ensuring the best illumination, had paid their own salaries and saved £E.52.

The new Police organization levied no fines at all in 1896, 1897, 1898 and 1899 (to April.)

All this time a staff of clerks was maintained costing £E360 p.a.: carriage hire for inspectors was allowed and the Government was mulcted during these years in a sum of £1,666 for the upkeep of an administrative office which, robbed of its executive staff, was absolutely useless. On taking over I at once reappointed a number of inspectors at a total of £E.135 or 59% economy on the original staff. In eight months fines to the value of £E.258 were inflicted, so, that while ensuring the maximum of illumination, the inspecting staff paid for its own upkeep and economised £E.123 to Government. The cessation of fines for four years was put forward by the Company as prima facie evidence of the lapsing of our fining powers. In spite of an adverse opinion given by our lawyers we have re-introduced and maintained our rights. The lighting is now excellent, thanks to the energy of Mr. Powell in whose charge I have placed the work.

Our present budget of £E.21,954 should be raised by £E.3,226 to allow of the establishment of 466 extra necessary lamps.

Sweeping and Watering Service. *Notes.*

GAS INSPECTION.

Year	Number of lamps	Employés.	Inspectors.	Carriage hire.	Lamps dispossessed paid by service	Total.	Fines	Cost of working.	Cost of working per 100 lamps.	REMARKS.
		££.		££.	££.	££.	££.	££.	££.	
1891	2,800	384	Police	60	86	530	139	301	10.75	
1892	2,900	384	"	60	70	514	100	310	11.72	Carriage hire should have come in reality to about ££20 per year, and in 1898 to about ££40.
1893	2,950	384	"	60	12	486	198	212	8.20	
1894	3,075	384	"	60	26	470	51	389	12.65	
1895	3,075	360	273	60	125	818	325	369	12.00	
1896	3,075	360	Police	60	75	495	2	418	13.06	
1897	3,075	360	"	60	79	499	—	420	13.06	
1898	3,075	360	"	36	38	434	—	396	12.88	
1899 to April *	3,171	396	"	36	14	446	—	446	14.00	4 months actual 1899
	3,171	456	135	—	29	620	258	333	10.05	With Rany — 8 months
1899 full year.	3,171	216	135	—	29	380	258	122	3.85	Without Rany - 1 year if Mr. Rany pensioned.

* F. W. D. 1899, April (8 months) to 31st October, November.

NOTE ON THE ELECTRIC LIGHTING SUPPLY IN CAIRO.

The electric light installation has increased considerably during the last year, in extent of network as well as in current consumption, and successful endeavours have been made by the Company to avoid irregularities in the supply and to prevent accidents.

The chief improvement was the laying of underground mains and distribution cables, both of which were overhead at the commencement of the undertaking. Considering the high pressure (2,000 volts) in the mains, this change was absolutely necessary, and had been foreseen by Government in the authorisation order of December 1897. In the six months since the completion of the underground network only one general break-down took place, and the nature of the circumstances from which it sprang justifies the hope that similar defects will not occur again.

GENERATING PLANT.

The supply station is situated in the suburb of Bulaq, some 1,500 metres from the centre of supply area. Its capacity, which was 800 HP. at the beginning of year, was to be increased to 1,200 HP., in order to satisfy the increasing demand for current. It now contains six generating units, each consisting of a Brown-Boveri alternator driven directly by a Sulzer horizontal steam engine.

The alternators are—with one exception—of the multipolar type with fixed armature and rotating field poles, generating single-phase alternating current with a frequency of forty cycles per second and a pressure of 2,000 volts. The switchboard has been completely changed, the former wood panels being replaced by an entirely fireproof construction in marble and iron.

NETWORK.

From the supply station the high pressure mains are supported on strong wooden standards as far as the city, where they are connected through the necessary switches and fuses to the underground network. From this point two feeders run to two distribution centres, and from there the high pressure underground mains distribute the current to about sixty transformer stations spread over the whole city.

The mains consist of lead covered and iron armoured concentric cables manufactured by the "Société Alsacienne de constructions mécaniques", Belfort, they are laid in the ground of the footpaths without any troughs or conduits at a depth of 60 centimetres.

At the street crossings they are protected by cast-iron pipes laid 1 metre under surface of the road.

All high pressure cables have been carefully tested with a pressure of 4,000 volts between outer and inner conductor.

TRANSFORMERS.

The step-down transformers reduce the pressure to 100 volts, they are, with the exception of some private transformers, installed in brick houses of 1.30 metre square area, situated on the footpaths.

DISTRIBUTION.

The distribution cables are placed underground throughout. The energy is now exclusively used for private lighting, all the public street lamps being lit by gas. An absolute impediment to the use of the current for the purpose of motive power was the fact that up to the present time current was only supplied from sunset to sunrise. Since the beginning of this month (April 1900) however, continuous supply has been effected, and some motors for lifts, fans, etc., have already been installed.

PRICE.

The charge for electric energy is on the metre system at an all-round rate of 1 franc, per unit. Thomson-Houston metres are in use.

The following table gives some technical and financial data compared with corresponding figures 1899:—

	YEAR ENDED.	
	March 31st 1899.	March 31st 1900.
<i>Quantities.</i>		
Units sold	169,673	246,234
Units per 8 c.p. lamps capacity	5.6	5.9
8 c.p. lamps connected	30,329	41,475
Arc lamps connected	60	77
Maximum supply demand	248 Kw.	336 Kw.
Capacity of plant	530 Kw.	888 Kw.
<i>Capital.</i>		
Expended (total) Frs.	986,717.57	1,995,586.21
Plant	748,350.34	1,109,535.13
Mains and miscellaneous	238,181.23	885,864.08
<i>Revenue.</i>		
Total revenue from supply Frs.	169,672.88	246,234.27
Works costs, (Total)	96,575.96	161,815.40
Fuel	42,969.26	74,337.17
Oil	2,742.94	3,709.02
Wages	32,359.79	50,119.95
Maintenance	6,138.47	7,933.75
Miscellaneous	12,365.50	25,715.61
<i>Financial results.</i>		
Cost of units sold Fr.	0.57	0.66
Price charged per unit	1.00	1.00
Percentage of total costs to gross Revenue	57.0%	65.6%

IT MAY BE INTERESTING TO COMPARE THE MAIN FEATURES OF THE CAIRO SYSTEM WITH THOSE OF SOME EUROPEAN TOWNS.

NAME OF TOWN.	POPULATION	PLANT CAPACITY.		CONNEXIONS.		PRICE PER UNIT IN CENTIMES.	
		in Kw	in 8 c p. lamps.	in 8 c p. lamps	Motors HP.	Light.	Power.
Cairo . . .	565,000	800	26,700	11,475	—	100	100
Glasgow . .	817,000	3,555	118,500	156,000	400	62-15	over 5 hours all 15.
Liverpool . .	641,000	6,300	210,000	224,888	142	41	20 & 10
Manchester. .	544,000	6,360	212,000	216,697	1,661	50 with sliding scale to 15.	13 under cond
Berlin . . .	1,677,304	18,348	611,600	443,467	9,245	75-60	20
Hamburg . .	625,552	7,308	243,600	156,672	1,646	75	25
Frankfort a. M.	229,000	3,120	104,000	113,818	1,508	77-50	25-20

HELOUAN WATER SERVICE.

The total amount of water supplied to this Service in 1899 was 233,810 cubic metres.

The revenue for this year is :—

	£E	Mill
From private consumers	1,632	245
From Government	1,011	100
Total	£E.2,643	345

The expense for the year as follows :—

	£E.
Purchase and laying new pipes	205
Purchase of 30 Frager metres	107
Total	£E.1,652 1,652 000
Gross Profit	£E. 991 345

The ordinary expenses for the year are in excess owing to the high price of coal. A supplementary credit was applied for and granted for the purpose of covering this extra expense of £E.170.

If the new pipes and water metres had been charged to capital account, the total gross profit would have been £E.1,303 345 mill.

On £E.10,000, a capital which would be ample for a complete water supply to any town of the size of Helouan, this would give a dividend of 13 % per annum.

The water is delivered and distributed through a network, the total length of which is about 23,500 metres.

The water is supplied to the consumers entirely by water metre, giving (to judge by the absence of complaints) general satisfaction—470 water metres are at present in use, supplying about 520 houses with a population of 5,000.

The price of water per cubic metre is 10 milliemes against 25 milliemes charged by the Water Co. in Cairo. 50 milliemes per month for rent of water metre is further levied.

This sum includes erecting the metre and all repairs.

The price charged in 1894 was 20 milliemes per cubic metre 100 millions rent of metre per month, erection and all repairs being charged to consumer.

Since this service was taken over from the former Administration, the whole system has been gradually remodelled: the town is practically divided into eastern and western halves by Mansour Pasha Street.

The supply to the lower part can be controlled so as to keep an equal pressure in the eastern or higher half. Each separate street can be cut off from supply without affecting the others, and in case of fire, the whole of the water can be concentrated in the one street. All valves are in good masonry walls with proper cast-iron covers. New reservoirs have been built of 500 cubic metres capacity. At the pumping station, a large new pump and boiler have been erected.

GHIzeh AND GHEZIREH WATER WORKS.

These pumps have as usual kept up a regular supply for the tenants of Finance land and for road watering. A suggestion put forward by Mr. Curtis, of which I strongly approve, to supply Gizeh (a town of 13,000 inhabitants) with drinking water from these pumps, was not accepted by the Finance Department. I trust the scheme is only postponed.

If the road to the Pyramids is to be maintained it will be absolutely necessary to lay pipes and furnish water under pressure: the existing *sakiehs* are quite inefficient, and the new road, which cost £E.2,226, is already showing sign of disintegration consequent on insufficient watering.

The cost of the pipe system required would be, approximatively for 8 kilometres length, £E.3,300. The upkeep of the pipe system would be about £20 per annum while the sakiehs require £350. The economy capitalised would come to about £8,000. The outlay is therefore quite justifiable.

BRIDGES.

The Benha old railway bridge has been opened to traffic and supplied with plank footpaths and a macadam roadway at a cost of £E.256. The temporary guide rafts constructed by your order have worked well. No accidents have been reported.

English Bridge and Kasr-el-Nil Bridge.—A portion of the flooring is in urgent need of repairs. Both bridges require painting. A credit of £2,936 should be added to my budget for this purpose.

									£E.
Flooring	English bridge	...	...	...	...	...	...	...	1,544
"	Kasr-el-Nil Bridge	...	...	...	...	...	...	...	320
									<u>1,864</u>
	Total	...	...	...	...	...	...	...	1,864
Painting both Bridges...	...	...	...	...	...	...	...	...	<u>1,072</u>
	Total	...	...	...	...	...	...	...	2,936

I hope that this expenditure may be debited against the £E.12,000 paid by the Tramway Company.

REPORT ON THE SURVEY DEPARTMENT,

1899.

BY

CAPT. H. G. LYONS, R.E.,

DIRECTOR-GENERAL SURVEY DEPARTMENT

REPORT ON THE SURVEY DEPARTMENT FOR THE YEAR 1899.

Throughout the year the Survey Department formed in 1898, as described in last year's report, has worked as a single Department, and though, certain changes which will be mentioned, have largely increased the work, it has been possible to cope with this much more efficiently than would previously have been the case.

The partially completed triangulation of Gharbia, which had been in Triangulation. hand during 1898, was stopped since the detail survey there was already far advanced, and the only two triangulators were employed in the Fayum. The major triangulation, consisting of a network of fifty triangles of from 8 to 10 kilometres side on the average, was completed by the autumn, and the reduction of these is now in hand, while about two-thirds of the minor triangulation in the same province has been observed. This latter consists of a network of triangles of about 2 to 3 kilometres side, furnishing the fixed points for the theodolite traverses which in turn provide the points for the detail chain survey. Thus it has not been possible with this very small staff of two triangulators to complete the triangulation of a single province of 300,000 feddans in a year. As was pointed out last year, this is less than half the area annually required to be surveyed in detail in order to prepare a sufficient number of villages for the Commission charged with the Re-assessment of the Land Tax; and it is impossible to ensure accurate results over large areas if an exact triangulation is not available as a check upon errors which must occur, and which very rapidly accumulate.

In utilizing the triangulation of Giza Province, which was carried out in 1897 by the approximate methods mentioned in the report for 1898, numerous small discrepancies were found, but it was usually impossible to determine whether the traverse work or the triangulation were in fault, since the triangulation was not sufficiently accurate.

Another objection to the present method of working by theodolite traverses without triangulation that each village being traversed separately as a closed traverse, it frequently happens that differences occur between the boundaries of two neighbouring villages. Each traverse having been corrected as a closed traverse, it does not follow that they will be absolutely in accordance on a common boundary: this has now been ensured as far as possible, but the checking of common boundaries causes much delay, which would be avoided if traverses could be run between fixed triangulation points.

Though the field work in triangulation has been very small in amount in consequence of the small staff available, efforts have been made to prepare as far as possible for an extension of work, as soon as funds will allow: the Geodetic Base measuring apparatus of the pattern known at the Brünner-Ibanez, has been examined, and found on the whole to be in very good condition. The bar itself is now in Paris for cleaning and re-engraving the dividing lines which had been somewhat damaged, and the Committee of the International Geodetic Congress have kindly consented to allow the bar to be compared with the International Standards at the Bureau International des Poids et Mesures, at Sèvres. This work will, it is understood, be undertaken in the course of the year 1909, and the bar should be in Egypt again by the end of that year.

The three large Geodetic theodolites by the same maker, Brünner, have been for the last eighteen years at the Observatory, but, though originally first-class instruments, they have been so neglected in the past that the necessary repairs are costly to carry out.

Besides these, all the theodolites constructed by well-known firms which were lying in the Ministry stores and were too large to be useful to Irrigation and Tanzim Engineers, such as 12 inch, 10 inch, and 8 inch, theodolites, have been repaired and cleaned by the makers and are now ready for use whenever the necessary personnel can be provided for more extensive triangulation work.

Revenue
Survey, Work
executed.

At the commencement of 1899 the Revenue Survey was being carried on by five Taftishes which were working in the following Merkazes:-

No. 1 in Ayat and Saff	}	Giza Mudiria.
No. 2 in Giza and Embaba		
No. 3 in Talkha and Sherbin	}	Gharbia Mudiria.
No. 4 in Ashmun		
No. 5 in Tala		

The total new area surveyed during the year by the above Taftishes was as follows:—

No. 1.	. . . . .	87,701 feddans.
No. 2.	. . . . .	89,946 ..
No. 3.	. . . . .	96,000 ..
No. 4.	. . . . .	37,801 ..
No. 5.	. . . . .	<u>51,817</u> ..
Total. . . .		363,265 feddans.

The total in 1898 was 948,000 feddans.

This very large difference is due principally to a radical change which was made during the year in the procedure followed in making up the village registers.

After the maps of a village have been made and also the *Daftar-el-Messaha*, (which is essentially a detailed index to the map,) the next document of importance is the *Mizzania* in which all the areas of land in the village belonging to one owner are collected together to form the total area owned by him, and on which he pays tax, and this total is compared with that previously recorded against him in the books of the *Mudiria*.

From the date of survey this tax is raised or lowered according as the area is found to be greater or less than that previously recorded.

All work connected with the preparation of this *Mizzania* and the determination of the deficits or excesses of area, was carried out by the Government Lands Department of the Ministry of Finance, but when the Re-assessment of Land Tax commenced, this extra step in the procedure was found to lead to a considerable loss of time, and from 1st June, 1899, the Survey Department was ordered to complete also the *Mizzania* of each village and to transmit the whole series of maps, registers, and documents, direct to the Revenue Department of the Finance Ministry.

This threw a large increase of work on the staff of the Taftishes of the Survey Department in doubling the amount of records in each village to be prepared; but besides this there were a very large number of villages (326) which had been completed under the old system, and passed to the Government Lands Department for settlement, but which this Department had not been able to finish.

All these were returned to the Survey Department to revise, bring up to date and complete.

In Egypt where small plots of land, and even fractions of these, are constantly changing hands the revision of a village register after one or two years necessitates alterations in about half the entries, and this will show the amount of extra work thrown on the Survey this year, thus accounting for the small amount of field work executed.

The following table gives the area received back for completion from the Government Lands Department together with the years in which the field survey was done and forwarded to them:—

YEAR.	Province.	Villages.	Area in feddans	TOTAL.	
				Villages.	Area in feddans
1895	Behera	3	27,809	3	27,809
1897	Behera	4	7,524	—	—
1897	Sharqia	2	9,763	6	17,287
1898	Gharbia	205	497,569	—	—
1898	Behera	28	74,021	233	571,590
1899	Gharbia	78	154,177	—	—
1899	Behera	6	17,390	84	171,567
Total. . .				326	788,253

or more than three quarters of a million feddans.

To deal with this mass of revision the 5th Taftish under Ahmed Effendi Tewfiq took up this work exclusively, ceasing work in Merkaz Tala, Mudiria Menutia, where forty-one villages had been commenced in the first five months of the year.

Fifty subordinate employes, register writers, etc., were transferred from the Government Lands Department for this work, but no Engineers or Inspectors.

By the end of 1899 the following amount of revision had been done:—

MUDIRIA	Villages.	Feddans
Behera	43	116,909
Sharqia	2	9,783
Gharbia	71	241,120
	116	367,812

leaving about 219 villages and 117,000 feddans to be dealt with. These represent the greater part of Gharbia, where the land is greatly subdivided.

As the Re-assessment Commissions have been rapidly pushing on their work in Behera and Sharqia, it was necessary at the end of 1899 to add the 1st Taftish under Mr. G. W. Fraser to the 5th Taftish, in order to proceed more rapidly with the revision, and to complete it if possible in 1900.

Up to the 31st December, 1899, the survey of villages stood as follows:—

MUDIRIA	Not commenced	Awaiting revision	Under survey	Sent to Finance	Total
Behera	—	—	8	308	316
Sharqia	—	—	2	387	389
Gharbia	25	193	102	189	509
Giza	37	—	129	—	166
Menufia	59	—	78	—	137

During the past year the Ministry of Finance granted the necessary ^{Survey offices,} funds to build new Offices for the Survey Department at Giza, where the whole of the personnel of the Central Office could be accommodated, and where maps and documents could be safely stored, while greater facilities for the instruction of engineers and surveyors could be enjoyed than in the middle of Cairo.

The buildings were completed by the end of October, and during November and December the whole staff were transferred there.

Accommodation is provided for the clerical staff, and the personnel of the drawing and printing offices, while for the present also the two Taftishes, 1st and 5th, which are engaged upon the revision of the land registers received from the Government Lands Department, also work in the same building.

The total number at present working in the Survey Offices at Giza is 225 employés.

The Map and Record Room, which has been placed in charge of Robert Bey, now renders it possible to have the whole of the maps and documents of the Public Works Ministry which relate to Survey matters properly registered and stored in one place of security.

Both for convenience of reference and for facility of publication this will be great gain, while the original maps themselves can be better taken care of, and many of these are already in a very torn and damaged state.

A large room is allotted to the technical stores and camp equipment of the Department which can now for the first time be properly arranged.

The Drawing and Lithographing Office under Rayon Bey, charged ^{Drawing offices} with the reproduction of maps, has been quite unable to cope with the very large amount of extra work which the transfer of the Revenue Survey and the printing of village maps has thrown upon it.

Since, however, the return of 326 villages for revision, as explained above, has postponed the date of their final transmission to the Finance Ministry, the Drawing Office was able to get through the greater part of the year without any considerable arrears accumulating, but by November and December these began to be felt and in 1900 they will be unavoidable with the present personnel, and the methods employed.

Funds have been granted to provide buildings for photographic reproduction of maps, but this cannot be ready till 1901 at the earliest, and not till then therefore will it be possible to commence the printing of district maps on a scale $\frac{1}{25000}$ which are very urgently required by the Irrigation Circles.

The work of printing village maps was commenced during the year and thirty villages were printed before December. This work is now well in hand and is being pushed on rapidly. The whole of the village maps of Menutia and Giza Mudirias will be printed.

Working hours.

Until November the working hours were 8.15 a.m. to 1.15 p.m. or five hours daily, which delays in commencing work, preparing colours, etc., probably reduced to a little over four hours per diem; it has therefore become necessary to work longer hours, viz., 8.30 a.m. to 4 p.m. with one hour's rest from 12 to 1 p.m. in winter, and from 7 a.m. to 12.45 p.m. in summer.

This has enabled a much larger amount of work to be completed.

Sale of maps.

The total income from the sale of printed maps, tracings, books, etc., was as follows:—

	£E.	Mill.
For printed maps	145	768
Tracings, books, etc.	139	552
Total	£E.285	320

showing an increase of £E.134 on the amount collected in 1898, but this sum will be largely increased when it becomes more generally known that maps and extracts from them are obtainable.

In November 1899, Mr. F. Diemer was appointed Agent for the sale of maps and publications of the Public Works Ministry in Cairo.

Scale of village maps.

Hitherto the scale on which the Revenue Survey maps have been made has been $\frac{1}{40000}$, but this has been found to be too small, and in future $\frac{1}{25000}$ will be employed.

Land in Egypt is very much subdivided, and many of the plots in a village consist of long strips of land from 5 to 10 metres wide only.

Since a qirat and a sahm on the $\frac{1}{4000}$ scale are represented by 10·9 and 0·46 square millimetres respectively, it is impossible to show the areas of the small plots with the necessary accuracy.

It is naturally the number of these small plots which take up the time occupied by the Survey, since the entries in the village registers increase in proportion.

Days required for a survey of a village consisting of 2,500 feddans from the work of 1899 were :—

Maps.	Records.	Total days.
91·6	204·7	295·7

Recent changes in the village registers have reduced this figure to 275 days, but even taking this, the average out-turn of a Taftish at present will not exceed on the average 80,000 feddans a year.

Up to 31st December, 1899, the total village area surveyed :—

Surveyed up to 31-12-99	2,589,000 feddans
Leaving to be surveyed about	1,129,000 „
Estimated total in Egypt	<u>6,718,000 feddans.</u>

The Abbassia Observatory was transferred from the Ministry of Public Instruction to that of Public Works in February, 1899, and was attached to the Survey Department. During this year most of the instruments have been cleaned, repaired, or replaced by new ones, but the hours of observation, viz : every three hours throughout the twenty-four, were continued although the results were not altogether satisfactory. In the meantime self-registering thermometers and a self-registering anemometer were put up, and a recording barometer ordered in order to be able to commence continuous Meteorological records in 1900. Of these the barometer had not arrived by the end of the year, but the others were in order and working. A Milne's Seismograph for recording earth tremors, which had been purchased by the Ministry of Public Instruction in 1898, was also installed, and worked well as soon as a few difficulties which arose at first had been overcome. One of the Observatory clocks was taken to England last year for cleaning and to have electric contacts fitted to it. By the kind permission of the Astronomer Royal it was tried at Greenwich Observatory, and, being found satisfactory, was returned to Egypt and mounted as a standard mean time clock in the Observatory. By the commencement of January, 1900, it was in order and was automatically transmitting hourly signals to the Ezbekia Central Telegraph Office, so that since that date the Observatory has been in a position to drop time balls at

Port-Said, Alexandria, etc., as soon as the necessary connections are made by the Telegraph Administration. The whole of these instruments have been in the charge of Mr. E. B. H. Wade, M.A., who has taken great pains with their installation and adjustment, and who has also, since the illness of Ibrahim Bey Esmatt, the Chief Observer, in December, had the whole charge and direction of the staff, etc.

Chemical
Laboratory.

During the year Mr. A. Lucas, the analyst, has examined 122 samples consisting principally of rocks and ores collected by the Geological Survey, and of building materials received from the Tanzim Department. A small laboratory has been built and fitted up near the Ministry of Public Works, and was taken over at the end of the year. The experience already gained shows that there is almost more work than can be dealt with, and already samples being received from all Administrations of the Ministry.

Now that a well equipped laboratory is available, this work can now be more quickly satisfactorily dealt with.

Geological
Survey.

During 1899, four survey parties have been in the field continuously for four months. During that time two parties were engaged on the Peninsula of Sinai, while the other two were at work in the Fayum and different parts of the Nile Valley.

In Sinai the part to the west of the watershed has been surveyed by Mr. Barron from its most southerly point, Ras Mohammed, to the escarpment of Jebel el Tih and north to Suez. During the work many interesting facts have been collected which throw light on the earth movements which have given rise to the peninsula.

The iron and manganese ore deposits which were known to occur in Wadi Nash have been examined, and their distribution shown to be much greater than was previously supposed. Several samples of these ores have already been analysed, the best of them yielding 98 % Fe_2O_3 , while others contain varying proportions of manganese and iron oxides.

The turquoise mines at Maghara were also specially examined and reported.

The eastern half of Sinai has been completely mapped from Ras Mohammed up to the 29th parallel of latitude. This hitherto little known district has been completely surveyed topographically and geologically and as result of this, some remarkable "rift-valleys" have been shown to exist more or less parallel with that of the Jordan-Aqaba depression.

Good iron ore exists towards the centre of the peninsula, but the conditions are unfavourable for working it.

In the Nile Valley and Fayum the work has been pushed forward rapidly, and the whole of the cliff round the Fayum has been mapped by Mr. Beadnell, as well as the Wadis Moela and Rayan. In addition the cliff on the west side of the Nile Valley has been surveyed from the Fayum southward as far Assiut; and the eastern cliff including Wadi Assiut and others from El Maabda to Qina.

The Nile Valley has also been mapped in detail on a scale of $1:100,000$ from Assuan to Korosko by Dr. Ball, but early in the year the party at work at this point, was recalled to Shellal to make a detailed geological survey of the first cataract on the same scale, which was finished early in 1900.

During the season about 180 field maps have been added to the collection, all of which (except those of the Cataract and up to Korosko) are on a scale of $1:500,000$.

The fifth geological party has been stationed in Cairo, and was engaged in arranging the collection of fossils in Kasr el Aini. Except for one or two short excursions this party was not in the field.

At the end of June Dr. Blanckenhorn, who represented this party, resigned, and his post has not been filled.

Over 3,000 specimens have been added to the collection during the year, some of which are of great interest.

H. G. LYONS.

REPORT ON THE TECHNICAL DEPARTMENT.

1899.

BY

MD. ANIS BEY.

CHIEF OF TECHNICAL DEPARTMENT

TECHNICAL DEPARTMENT.

YEARLY REPORT. 1899.

In my last year's report mention was made of the disadvantageous ^{Steam engine service.} position in which this Service was placed with regard to its intricate and perplexing laws, and of the Mixed Commission which was formed about the latter end of 1898 for the purpose of enquiring into this question.

This Commission, after carefully going into the matter and examining every point under dispute, advised the abolition of the existing laws and the introduction of new ones. A draft of a new set of regulations was therefore submitted to this Commission and approved by every one of its members.

The Ministry lost no time in taking the necessary steps to carry out this decision, and the proposed law has already passed through the Legislative Committee, the Legislative Council, and Council of Ministers. It remains only for it to be ratified by the Mixed Court of Appeal to pass as law applicable to both native and foreign subjects.

The delay caused by this procedure could not be helped but, it is much to be deplored, for the Service had to carry out its work during all the year under the same unfavourable conditions as the year before, and consequently lost more prestige and power than was desirable.

The result of the year's work under these circumstances was as follows :—

169 roksas were granted, of which 16 were for gas and oil engines.

147 boilers were examined and tested, 109 were given the certificate and allowed to work, and 32 were found unsatisfactory and were not allowed to work.

6 oil engines and 6 irrigation and flour-mill engine boilers were also examined and passed.

218 visits of inspection were made to these boilers.

Most of this inspection was at request of the owners.

The boilers inspected were only those newly licenced.

No forcible inspection could be made during the year, for all legal actions against steam users being stopped by the advice of the

Contentieux, the Service had no power left to enforce its control. I should however mention that, a few cases of contravention for want of Rokhsas were made by the police without our knowledge: but whether these cases were for failing to have Rokhsas for the industries, or Rokhsas for the engines, I cannot with certainty say, but I presume it was the latter, from the fact of some complaints coming to me against the action of the police, and also from the judgments given by the courts being sent to the Technical Service for information. These judgments were as follows:—

36 cases from Mixed Courts	{ 15 acquittals. 21 a few piastres fine.
6 cases from Native Courts	{ 2 acquittals. 2 a few piastres fine. 2 stoppage of engine.

Had it not been for this interference of the police the small number of demands for Rokhsas would most likely have been still reduced, for the Service would have been left entirely dependent on the will of the steam engine owners, very few of whom knew that what the Service was doing was really in their own interests. This ignorance is shown not only by natives but also by many Europeans who own large establishments, and who should know better. Some of the boilers in these establishments are in such a bad state that it can hardly be wondered at when explosions take place—it is only marvellous that there are so few.

As an example of this ignorance and neglect I will quote the following case, taken from Mr. Crawley's report, in his own words:—

"I have found some large firms working their boilers in a very unsatisfactory and even dangerous state.

"One instance would, I think, be interesting. A firm at Mansourah I found working two boilers of large diameter which were built in 1871 to supply steam to an ordinary one-cylinder engine, as this engine did not prove economical they compounded the engine by adding another cylinder, and continued to work the same boilers, now twenty-eight years, old at 100 lbs. on the square inch. I found also that the safety-valves were loaded above that pressure."

If these engines were compounded, new boilers should have been procured, the old boilers being thirty years old could not be considered safe to work even at the lower pressure they were originally built for.

This is only one instance of many which, if vigorous inspection were carried out, would certainly be cleared away, and many valuable lives saved.

Of these old boilers three exploded during the year 1899, one in a workshop at Zagazig, and two in irrigation pumping stations.

The one at Zagazig occurred on the morning of the 29th May, in the workshop of M. Marius, the Vice-Consul of France at that town. It was a vertical boiler about thirty years old, employed to supply steam to a small engine in the workshop.

The cause of the explosion was excessive corrosion which had eaten away the plates and stays, extra pressure, and unpardonable neglect. The fireman was dangerously wounded by the force of the explosion, and succumbed the next day to the injuries he received.

The other two explosions have occurred through similar causes, and it need only be said that four were killed by one, and two by the other.

Mr. Crawley and his staff of Engineers and clerks have done their best to carry on the work of the service during the year with great skill and perseverance, and deserve high credit for the result they have accomplished under the most trying circumstances in which they were placed.

35 Rokhsas for irrigation fixed engines were delivered during the year 1899 as against 47 in 1898. The number of Rokhsas sanctioned to the end of 1898 being 746, the total number to the end of 1899 will be 781. Of this total 39 are cancelled and 742 remain effective. Their distribution is shown as follows:—

	Cancelled.	Given in 1899	Effective to end 1899
1st Circle	15	4	204
2nd	19	24	285
3rd	1	2	97
4th	3	3	127
5th	—	2	20
Guirga Directorate	1	—	9
Total	39	35	742

The fees received for the 35 new Rokhsas were £E.325.

In my last report I mentioned that the Rokhsas for quarries given by the service were of two kinds—old ones which entitled the owners to work the quarries for life, and new ones which limited the time to ten years—and that the total number remaining of each kind to the end of 1898 was—

Old Rokhsas	156
New Rokhsas	465
Total	621

In 1899, 18 old Rokhsas were cancelled; 14 by the death of the owners, 2 by the request of the Antiquity Service, and 2 in exchange for new Rokhsas. Thus 138 remain.

From the 465 new ones 21 were also cancelled; 20 by expiration of time, and one by exchange.

Adding 45 new Rokhsas (including the two exchanges) delivered this year to the remaining 444, the number of new Rokhsas to the end of 1899, comes to 489, and the total number now in handwill thus be:—

Old Rokhsas	138
New Rokhsas.	489
Total	<u>627</u>

Adding the 62 cancelled during the last two years it will be seen that the total number issued is 689.

The collection of Gypsum (Plaster of Paris) from the top of the Mokattam was formerly allowed without Rokhsas. This is now stopped and the space between Cairo and Helwan was in 1899 divided into three zones, and put up for adjudication as is done with ordinary quarries. The result of the adjudication was that one took a Rokhsa for two zones and another took a Rokhsa for the third; the fees for the two Rokhsas came to £E.880, the term being restricted to five years instead of ten.

The fees received for the other 43 new Rokhsas were £E.909,200 mill.. The total received for the 45 given during the year will thus be £E.1,789,200 mill.

Central Stores. The stores purchased and entered in the Ministry's Central Stores during the year 1899, cost £E.1,051,632 mill. Of this sum, £E.917,457 mill. was for technical instruments and camp equipments, and £E.134,175 mill. for office furniture. The details of the above are shown in the following statement:—

Technical Instruments and Materials.

	£E. Mill.	£E. Mill.
Purchased from England	447	865
.. France	49	148
.. Germany	11	760
.. Switzerland	30	054
.. Egypt.	29	415
	<u>568</u>	<u>242</u>
Made by War Office	295	086
.. Arsenal	52	947
.. Watering and Scavenging Service	1	182
	<u>349</u>	<u>215</u>
Total	£E.917	457

Office Furniture.

	£E. Mill.
<i>Brought forward.</i> . . .	917 417
	£E. Mill.
Made by Arsenal	119 300
„ Guizeli and Ghezireh Water Service	6 154
Purchased in Cairo	8 721
	<u>134 175</u>
Grand Total.	£E.1,051 632

The value of the articles delivered from the Stores was £E.1,691,635 mill., distributed as follows:—

	£E. Mill.
Irrigation Services	677 560
Building and Tanzim	509 126
Administrative Service	72 005
Technical Service	23 632
Antiquity Service	31 219
Survey Department	318 023
Reservoir Service	60 000
Total	<u>£E.1,691 635</u>

The work of the Technical Service Bureau is shown in the following Central
bureau.
statement:—

YEAR	Correspondence received	Correspondence issued	Orders to Arsenal for execution of work.	TOTAL.
European Office				
1898	2,448	1,644	643	4,735
1899	2,017	1,329	580	3,926
Arabic Office				
1898	2,864	2,962	—	5,826
1899	2,550	2,587	—	5,137
				Cheques
1898	—	—	—	648
1899	—	—	—	627

I have much pleasure in stating that every one of the staff has done his duty to my entire satisfaction.

The total output of the Arsenal in 1899 came to £E.23,283. Of Arsenal and
Boats.
this amount, the value of the work executed for the different branches of the Public Works Ministry, including the cost of repairing the boats

and maintaining the Arsenal plant, amounted to £E.18,287; other Government Departments ordered work to the value of £E.671; the Army of Occupation to £E.316, and private individuals to £E.898. The balance, amounting to £E.3,111, represents cost of fuel, oil and sundry stores.

The sum of £E.18,287, being the value of work executed for Public Works Ministry, was distributed as follows:—

	£E.
Irrigation Circles, Upper and Lower Egypt	9,085
Reservoirs Service	1,762
State Buildings and Tanzim Service	3,320
Survey, Administrative and other Services	950
Repairs to Steamers and maintenance of plant	3,170
Total.	<u>£E.18,287</u>

The Irrigation Circles were chiefly supplied with steel pipes, cast-iron grooves, and regulating timbers.

303 tons of steel pipes were made for the 1st and 2nd Circles at the value of £E.4,501, including freight, or at the rate of £E.14.85 per ton. In the previous year the rate had been reduced to £E.13.3 per ton, but considering that in 1898 steel plates were bought at £E.8.500 and in 1899 at £E.10 per ton, it will be seen that in spite of the higher price of fuel the Arsenal had kept the reduced rate of work the same in the two years, the difference in the rates charged being solely due to increase in cost of material.

289 tons of cast-iron grooves for regulators were supplied at the cost of £E.2,864, and 1,903 timbers for the same at £E.1,207. The rate per ton of grooves came to £E.9.87 or £E.0.87 more than the year before, owing to the increase in the price of metal.

The Reservoir Service ordered 135 tons of cast-iron piles to be supplied within a very short time, and the Arsenal foundry not being able to turn out this quantity in the given time, I had to ask the help of Cook's factory, which supplied me with about 43 tons at the rate of £E.12 per ton. We charged for the quantity we made only £E.10 per ton, although many of the men had to work overtime.

The work ordered by the Building and Tanzim Service was of the same nature as before, the demand being chiefly for making and repairing carts. The quantity was much less this year than the year before, its value amounting to £E.3,320 in 1899 as against £E.4,687 in 1898. Of this amount £E.846.73 was the cost of 86 new carts of different descriptions, the rest being charges for repairs and work of various kinds.

The work executed for the other branches of the Ministry was mostly cabinet work for office furniture or instrument repairs. It was follows:—

	£E.
Survey Department	535
Administrative Service	316
Technical Service	43
Wadi Tumilat	56
Total. . .	<u>£E.950</u>

All the boats were thoroughly overhauled and repaired with the exception of the “Bulac,” which was almost renewed the year before.

A new hull was built for the “Meris” and her engines and boiler were well repaired. She was given a wider beam, and her cabins and deck were rearranged so as to make her a more serviceable boat.

The Police boat “Scout” was bought from the Ministry of the Interior for £E.700, paid out of the Technical Service Budget, and as she was in the most dilapidated condition and almost in a sinking state, she was immediately taken in hand and put under general repairs. Her hull was partly renewed and her engines and boiler were in good working order, and I hope she will be ready this season to do duty in place of the “Messir,” which is very expensive on account of her great coal consumption, burning nearly 13 kantars per hour, whereas these small boats burn only from 2½ to 3 kantars per hour. The “Messir” will be kept for extraordinary commissions.

As the Service was short of small barges, which are very handy for the transport of material and finished work, two were ordered to be made in the Arsenal, one is finished and is now doing good service, the other is still under construction.

In the Arsenal, a new sawing machine and a new roller were erected in the fitting shop, some of the existing machines were overhauled and put in order: the dredger was repaired and a quantity of mud was cleared from under the Arsenal crane: some new tools were made for the Arsenal Store, some gas-pipes laid, and a new office was built for the use of the clerks.

The materials bought for the Arsenal during the year came to £E.14,130; of this amount, £E.4,730 worth was ordered from Europe and £E.9,400 from local merchants.

The total paid for labour during the year was £E.5,140. I am glad to say that the Arsenal is keeping up to its standard of efficiency. The prices charged were a little higher this year than the year before, but taking into account the great increase in the price of materials and fuel,

which in some cases reached 30 or even 40%, it will be seen that the Arsenal has actually effected some economy, and there is every reason to hope for still further improvement in this direction.

At present the workshops answer all our requirements and there is no necessity for increasing them unless called upon by pressure of work. The roofs are getting dilapidated and require extensive repairs. I hope to be able to do at least a part of them this year.

In conclusion, I cannot but express my satisfaction with the state of the work turned out by the Arsenal, for which great praise is due to Mr. Curtis, the Chief Engineer, and to his staff.

M. ANIS,

Chief of Technical Department

RAPPORT SUR LE SERVICE DES ANTIQUITES

PAR

G. MASPERO,

DIRECTEUR GÉNÉRAL

RAPPORT SUR LE SERVICE DES ANTIQUITÉS.

A S. E. le Ministre des Travaux Publics.

MONSIEUR LE MINISTRE.

Remis à la tête du Service des Antiquités au mois de novembre 1899, le rapport que vous me demandez de vous présenter ne peut être ni très étudié, ni très complet. Je me bornerai à vous indiquer brièvement les changements survenus dans le personnel, l'état des recettes et des dépenses, les principaux travaux exécutés au cours de cette année par l'ordre de mon prédécesseur, ou par le mien.

I. — Personnel.

Les changements suivants sont survenus dans le personnel encadré :

1° M. Loret, directeur général, démissionnaire le 1^{er} novembre, a été remplacé dans ses fonctions, à la même date, par M. Maspero, déjà directeur de 1881 à 1886 ;

2° M. Quibell, attaché au catalogue, a été nommé inspecteur général, à partir du 1^{er} novembre 1899 ; M. Howard Carter, engagé à la même date, aux mêmes fonctions, n'a pris définitivement son rang qu'au 1^{er} janvier 1900 ;

3° Youssef Ahmed El Saidi a été nommé inspecteur à Louxor, le 1^{er} février 1899 ;

4° M. Sobhi Arif, inspecteur de première classe, attaché jusqu'alors à la Direction centrale, a été nommé inspecteur à Dendérah, à partir du 1^{er} décembre 1899 ;

De plus, un certain nombre d'employés ont bénéficié au 1^{er} janvier 1899 d'augmentations plus ou moins fortes à leur traitement :

	L. E. Mill.
MM. Daressy, conservateur-adjoint	2 000 par mois.
Ahmed Bey Kamal, conservateur-adjoint	2 000 ..
Alexandre Baranti, conservateur-restaurateur .	1 500 ..
Mohammed Mahmoud, inspecteur d'Edfon. . . .	1 000 ..

La Commission du catalogue a été renouvelée presque entièrement. M. le D^r Borchardt, démissionnaire le 1^{er} septembre 1899, a été remplacé le 26 octobre par M. le D^r Schäfer, de Berlin.

M. le D^r Reisner (américain) est démissionnaire du 1^{er} novembre 1899: en prévision de sa démission, on avait engagé, le 17 octobre, M. le D^r Lange, de Copenhague.

M. Chassinat, démissionnaire le 1^{er} novembre 1899, a été remplacé le même jour par M. Lacau, membre de l'Institut Archéologique français.

Enfin M. Quibell, démissionnaire le 1^{er} novembre 1899, n'était pas remplacé encore, à la date du 31 décembre.

Le Comité demeurerait donc composé comme il suit :

MM. de Bissing (allemand),
Schäfer (allemand),
Lacau (français),
X (anglais),
Lange (danois).

II. — Recettes et dépenses.

Le budget pour 1899 comprenait au sous-chapitre 2, dépenses générales, la somme suivante :

	L.E.
Art. 1. — Service des fouilles et acquisitions pour le Musée.	1.800
Art. 2. — Frais de transport et de déplacement	432
Art. 3. — Menus frais	300
	<hr/>
Total.	L.E. 2.532

Les comptes divers ouverts pour le bénéfice du service et dont les revenus lui demeurent acquis: *Compte touristes, Entrées du Musée, Ventes d'objets antiques*, ont fourni les recettes suivantes :

	L.E.	Mill.
1 ^{er} Touristes.	1.491	582
Solde restant au 30 juin 1898	2.609	400
Recettes du 10 juillet 1898, au 30 juin 1899	<hr/>	<hr/>
Total	L.E. 4.100	982
2 ^{es} Entrées du Musée.	646	100
3 ^{es} Salle de vente.	386	790

Les dépenses effectuées sur ces ressources diverses se sont réparties comme il suit :

1^{er} COMPTE FOUILLES.

	L.E.	Mill.
Loyers des magasins du Service des Antiquités	24	000
Salaires des gaffirs réguliers	204	370
Transport d'eau et passage du Nil pour le compte de l'Inspecteur de Gournah	31	500
Divers	32	798
Remorqueur	123	195
Fouilles à Sakkarah (Loret)	170	495
„ Sakkarah (Maspero)	78	836
„ Mit Rahineh (Loret)	5	260
„ Mit Rahineh (Maspero)	5	880
„ Abydos (Loret)	3	910
„ Abydos (Maspero)	3	600
„ Biban el Molouk (Loret)	518	435
„ (eau)	74	750
„ (divers)	31	305
El Hawawiche	0	600
Dérouta	5	220
Colonne B. E.	5	618
Achats	2	575
	<u>1,622</u>	<u>347</u>
Transfert du Compte fouilles sur frais de déplacement	200	000
Total.	L.E. 1,822	347

Les 22 L.E. 347 mill. d'excédant ont été réglées en janvier 1900 sur le budget nouveau.

2^{es} COMPTES TOURISTES, DU 1^{er} JUILLET 1898 AU 30 JUIN 1899.

	L.E.	Mill.
Kom Ombo	7	436
Edfou	16	140
Louxor	27	840
Karnak	1,531	626
Médinet-Habou	401	669
Biban el Molouk	38	848
Abydos	2	200
Gizéh	2	030
Divers	84	998
Appointements des gardiens	<u>1,314</u>	<u>958</u>
	L.E. 3,433	360
qui, retranchées de la recette totale	L.E. 4,100	982
indiquée plus haut laissent à la date du 30 juin 1899, un solde de	L.E. 667	622

3. RÉSULTATS DES FOUILLES ET TRAVAUX.

Les travaux ont été concentrés cette année sur quatre points principaux, Karnak, Bilan el Molouk, Médinet-Habou, Sakkarah.

1. *Karnak*. — M. Legrain a continué les travaux de consolidation des colonnes de la salle hypostyle de Karnak. La colonne penchée avait été démantée, puis réédifiée en partie et trois autres colonnes étaient en pleine reconstruction, lorsque, le 3 octobre 1899, pour des raisons encore obscures, onze colonnes s'écroulèrent au milieu du bas-côté nord de la salle. A la suite d'une enquête spéciale qui déchargea le Service de toute responsabilité dans la catastrophe, M. Legrain fut renvoyé sur les lieux et, dès le 15 décembre, les travaux de déblaiement commencèrent sur une somme de 250 L.E., empruntée en avance au budget des fouilles pour 1900. Pendant l'été de 1899, M. Legrain découvrit et déblaya dans la grande enceinte, le long du mur est, au nord de la grande porte de Nectanébo, un temple d'Osiris, construit par les souverains de la XXII et de la XXIII dynastie. Une monographie de ce temple a paru dans le *Recueil des Travaux*, t. xxii, 1. 1-3.

2. *Bilan el Molouk*. — M. Loret a continué les recherches qu'il avait entreprises dans la vallée des rois au cours de l'année précédente. Il a opéré des sondages le long des rochers, au voisinage des hypogées de Thoutmosis III et d'Aménôthès II et il a découvert, en dernier lieu, l'hypogée de Thoutmosis I. Cet hypogée n'avait pas été décoré : il ne contenait que le sarcophage et une boîte à canopes : la momie du souverain est au Musée depuis 1881.

3. *Médinet Habou*. — Les travaux commencés par M. Daressy pendant les années précédentes, ont été achevés par lui cette année. En premier lieu, le pourtour extérieur du grand temple a été déblayé du côté nord jusqu'à la limite du dallage antique, sur une largeur de 8 ou 10 mètres sur une longueur de 100 mètres, et le mur d'enceinte reconstruit sur toute cette longueur. En même temps, une porte monumentale du temps de Domitien était reconstruite dans la grande cour avec les blocs retrouvés dans des constructions coptes, la voûte, avec sujets astronomiques de la chapelle d'Osiris, était remise en place, une statue colossale du dieu Ptah et une stèle en granit de 4 mètres de haut du temps de Thoutmosis III, étaient reconstituées et d'autres menus travaux rendaient facile l'accès du pavillon ou des terrasses du temple.

* *Sikharrâh*. — M. Loret a commencé, auprès de la pyramide de Teta, le déblaiement d'un quartier complet de la nécropole. Il a rendu compte de ce travail, qui a produit quelques découvertes remarquables, dans la séance de l'Institut égyptien du 5 mai 1899. Son rapport a été publié dans divers journaux et notamment dans les numéros 75 et 77 du *Journal du Caire* ; il paraîtra prochainement dans le bulletin de l'Institut égyptien.

M. Maspero a repris l'exécution du plan d'exploration des Pyramides qu'il avait commencé de 1881 à 1886. Chaque sépulture royale comprend la pyramide même avec ses chambres et ses couloirs qui débouchent au nord, sa chapelle attenante à la face est et qui renfermait les statues du roi, sur les faces nord-ouest et sud des souterrains qui pouvaient servir de tombeau aux membres de la famille ; tout cela contenu dans une enceinte rectangulaire dont l'aire était dallée. Il a ouvert les pyramides pendant son premier séjour ; il se propose maintenant de retrouver les chapelles et les souterrains. Il a commencé par la pyramide d'Omas, la seule qui soit ouverte aux voyageurs, et M. Barsanti a été chargé de l'exécution des travaux.

Partout ailleurs, il n'y a eu que des fouilles insignifiantes ou des travaux de restauration sans importance, réparation de mur, pose de portes, etayages d'une colonne ou d'un portique.

Tels sont, Monsieur le Ministre, les faits les plus importants qui se sont passés dans le Service des Antiquités au cours de l'année 1899. J'espère pouvoir vous présenter l'an prochain un rapport plus complet.

Veuillez agréer, Monsieur le Ministre, l'assurance de mon plus profond respect.

Le Directeur Général,

G. MASPERO.

REPORT ON AGRICULTURAL LINES.

1899.

BY

A. J. COTTERILL.

REPORT ON AGRICULTURAL LINES.

Cairo, 31st December, 1899.

SIR WILLIAM GARSTIN, K.C.M.G.,

Under Secretary of State,

Ministry of Public Works.

SIR,—I beg to hand you my annual report on these lines.

From the annexed Table No. 1 you will see that 339½ kilometres of line have been opened to traffic during 1899. The total length of lines were :—

In 1897	88 kilometres.
1898	355 ..
1899	694½ ..

A few projected lines, amounting altogether to 42 kilometres, have been abandoned, and 498 kilometres of extra lines have been, or are being asked for. The object of some of these extensions is to join up the lines already conceded and to convert them, for simplicity in traffic, into loop lines.

It is satisfactory to see that all the Companies are convinced that further extensions will lead to better receipts.

(2) *Competition*.—One agricultural line has greatly diminished the passenger receipts on a section of the State Railways, but the former is the direct route while the latter is most circuitous. Nothing has, I believe, occurred to show that any of the agricultural lines have caused the State Railways unfair competition.

(3) *Passenger Traffic Receipts*.—The passenger traffic has increased in a most satisfactory manner. As the figures given below do not refer to the same months nor to equal lengths of line opened, they cannot fairly be compared, but they show that the public is beginning to use these lines much more than was anticipated.

The number of passengers per kilometre of line and per annum has on the Delta lines latterly been 3,500 and on the Chemins de fer Economiques it has attained a maximum of 4,500.

Number	LINE	Number of passengers	Receipts	Approximate average cost of each ticket	Average distance travelled
			£ E	Millimes	Kilos
1	<i>Delta Light Railways:</i> 12 months ending Sept. 1899.	562,000	12,760	23	13
2	<i>Chemins de fer Economiques:</i> 12 months ending Nov. 1899.	654,000	13,250	20	19

As a proof of the popular desire for very low rates it is interesting to note that when the Chemins de fer Economiques reduced their minimum charge P.T.1 to P.T. $\frac{1}{2}$ the number of passengers increased during the first month by 60%, and the receipts were larger in spite of the general reduction in price.

(4) *Total Receipts.*—The total receipts on a newly opened line (part of a railway system) gives no true indication of its possible future, but it is gratifying to hear that the receipts on a small length of the Fayoum lines, that have been lately opened, reached immediately an average of £E.86 per kilometre and per annum. During the year ending September last the total receipts of £E.70 per annum and per kilometre were obtained by the Delta Company, but latterly they increased to £E.150 per annum and per kilometre.

I believe that the receipts of the Economiques have averaged about £E.100 and lately rose for a short time to a maximum of £E.170 per annum and per kilometre.

Their rolling stock was insufficient to carry all the cotton that was brought to them.

There is apparently no likelihood of the Government being called upon to pay any of the Companies the interest guaranteed them.

(5) *Through booking of goods.*—Has been established at the following stations:—Damanhour, Kafr Dawar, Benha and Mansourah. The first three stations are working well.

The public is not yet fully alive to the fact that goods can already be booked through from thirty stations on the State Railways to any station on the Agricultural Lines that is in communication with any of the above four stations.

(6) *Tariffs.*—The Companies have availed themselves of the provisional permission given them and have reduced their tariffs in many cases.

Where there was competition with water transport the reduction was found to be an absolute necessity.

If the Companies are not to be allowed a free hand in this matter, the Ministry should sanction special rates where no unfair competition with the State Railways would result.

(7) *Telegraphic and telephonic* communication has been installed on each line as under:—

	Lines opened	Telegraph.	Telephone
	Kilometres	Kilometres	Kilometres
Mansourah-Mattarich Line . . .	109	Nil.	109
Delta Light Railways	300	48	Nil.
Chemins de fer Economiques . . .	215·5	215·5	Nil.
Fayoum Light Railways	70	Nil.	77
		263·5	186
		449·5 kilometres.	

All the Companies seem disposed to enter into an arrangement with the State Railways to receive and forward messages over their lines. Each Company as well as the State Railway would keep their receipts.

In case of any difficulty arising the Light Railway Commission could arbitrate.

The Delta Company has less telegraphic communication than the other lines: I consider they would do well to extend it.

The Railway Commission should have the right of insisting on signals, telegraphic or telephonic communications being installed at junctions, and swing bridges if they are deemed necessary.

Art. 21 of the Cahier des Charges should be modified.

(8) *Locomotives*.—In estimating the cost of these lines six locomotives per 100 kilometres were allowed. This number has already proved to be quite insufficient if the proportion that must always be in depot, under repairs or washing out, is taken into account.

On the State Railways there are always 30% of the total number washing out and 12% in the shops under repair.

On the Agricultural lines there appears to be generally 25% of the engines out of work for similar reasons. It must not be forgotten that the dusty banks, and sometimes muddy tracks and the Nile flood-water all tend to make this percentage higher in Egypt than it would be in Europe.

This question of locomotives and the excess of capital required for them and other rolling stock is now (and will be more so in a year's time) a very serious question for some of the Companies. Table No. 2 gives some figures on this subject.

(9) Only one fatal accident has, as far as I know, occurred on any of these lines since they were opened to traffic.

It is most advisable that every serious accident causing personal injury, or any attempt to derail a train, should be reported by telegraph to the Railway Commission as well as to Police.

In cases of importance the Government Inspector should join the Company's delegate in making an enquiry and report.

(10) *Accounts and Reports.*—It would be a great convenience if each Company printed a yearly report, giving certain required details. A copy should be sent to the Railway Commission. A more precise annual report could then be sent to you.

The Financial year should end in September, so that an abnormally early or late cotton crop would not give rise to misleading statistics.

(11) *Lines in Villages.*—According to their Concession, the Companies have the right to lay their lines on all Agricultural roads even through villages. This has been done and has given rise to numerous complaints from the villagers. Great inconvenience if not danger is caused to the inhabitants of a village traversed by some of these lines. Article 5 of the Cahier de Charges should be revised.

(12) The special points to which I wish to draw attention are:—

- (a) The creation of a Light Railway Commission that would be authorised to examine and approve all further extensions and regulate special tariffs, and time-tables to insure proper connections with the State Railway trains.
- (b) The through transmission of messages over the Companies' wires and the modification of Art. 21.
- (c) The increase of the rolling stock, especially locomotives, and of the capital required for it.
- (d) The necessity of reporting accidents and making official inquiries.
- (e) The printing of yearly reports.
- (f) The revision of Art. 5 in respect to roads in villages

(13) The annexed plan shows the different lines opened to traffic and those that are in the course of construction.

I have the honour to be, Sir,

Your obedient servant,

A. J. COTTERILL,

Engineer in Chief

Egyptian State Railways.

DETAILS OF AGRICULTURAL LINES.
Report, December, 1899.

TITLE OF LINE.	Province.	Date of concession.	Term of concession.	Gauge of line.	Weight of rails in kilos per metre.	Length of line in concession.	Length of line opened to Decem-ber 1898.	Lanes abandoned.	Length opened to traffic during 1899.	Total length opened to Decem-ber 1899.	Extra lines being asked for.	REMARKS.
			Years.	Metres.	Kilos.	Kilom.	Kilom.	Kilom.	Kilom.	Kilom.	Kilom.	
Chemins de fer de la Basse Egypte, Mansourah-Matruh . .	Dakahlieh	June 1895	50	1.00	23.14	100	109	Nil.	Nil.	109	Nil.	
Chemins de fer Agri-coles, Delta Light Railway	(Behera) (Gharbieh)	March 1896	70	0.75	11.88	102	118	32	152	300	400	
Chemins de fer Eco-nomiques	(Charkieh) (Dakahlieh) (Kalloubieh)	May 1896	70	0.75	18	322	98	Nil.	117.5	215.5	43	
Fayoum Agricultural Light Railway . .	Fayoum	May 1897	70	0.75	15.8	116	Nil.	11	70	70	55	
						970	355	42	339.5	691.5	198	

English

DETAILS OF ENGINES ON AGRICULTURAL LINES.

Report, December, 1899.

Table No. 2.

Number	Type of Line	Total length 1899 Kilom.	No of train services	Average length of train service Kilom.	Present number of engines			Total number required according to opinion of Com. pany.	Engines per 100 kilometres of line.		Engines required per 100 kilometres, December 1899.	REMARKS
					at work.	under repair and reserve	Total		At work	Total		
1	Chemins de fer de la Basse-Egypte, Mansourah-Matruh	109	2	54½	4	5	9	9	3·67	8·25	8·25	It is believed that 6 locomotives per 100 kilometres could do the work
2	Chemins de fer Economiques	215·5	5	43·1	11	3	17	36	6·5	7·8	16·7	Said to require about 17 engines per 100 kilometres for lines opened
3	Chemins de fer Agricoles, Delta Light Railway . .	300	6	50	20	4	24	30	6·7	8	10	Said to require 10 engines per 100 kilometres
4	Fayoum Agricultural Light Railways	70	3	23	1	3	7	—	5·7	10	—	Requirements not yet established

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